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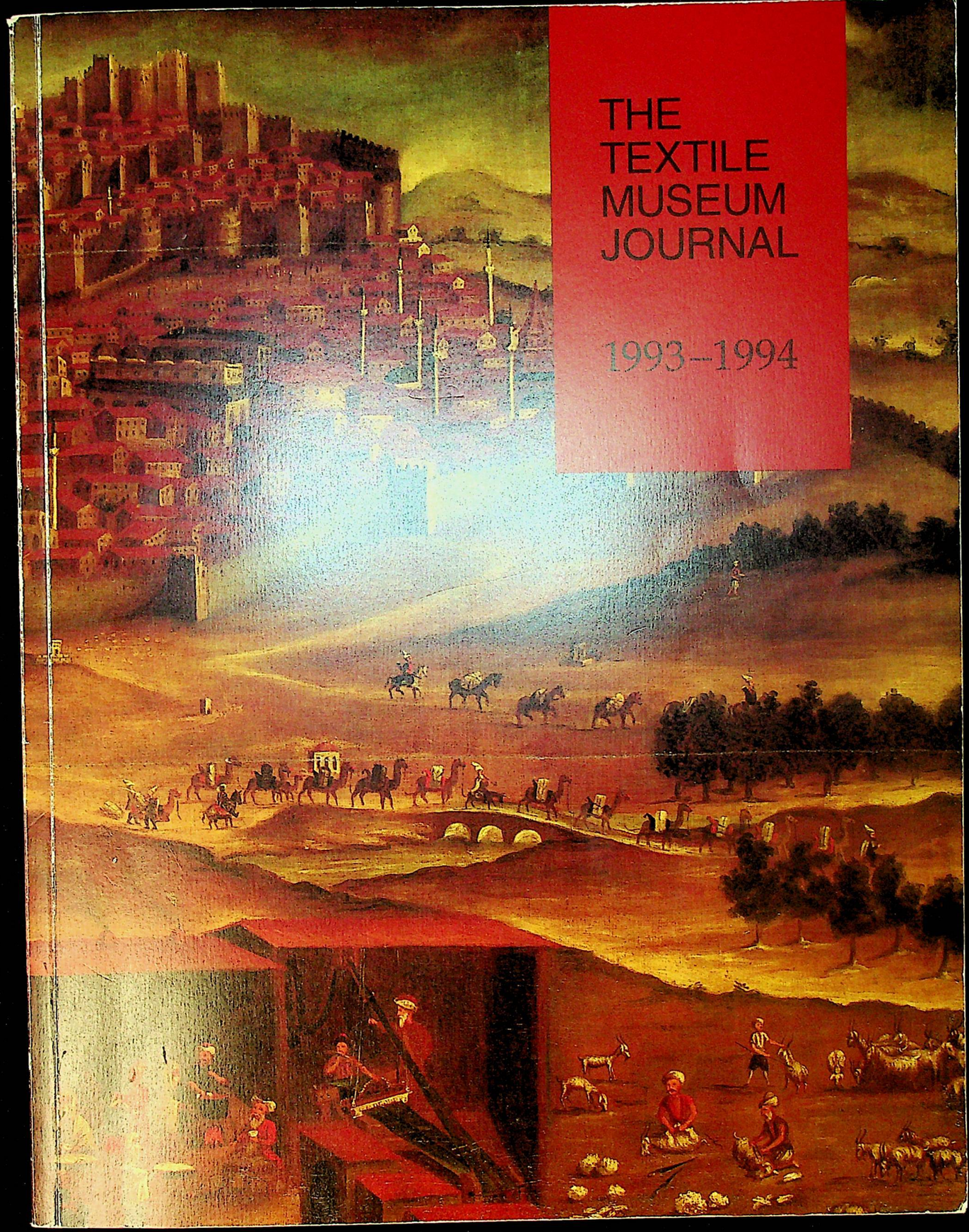
1993–1994



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Cover photo
A View of Ankara, 18th century, Rijksmuseum A2055, Amsterdam. See Gary Leiser, Travellers' Accounts of Mohair Production in Ankara from the Fifteenth through the Nineteenth Century, pp. 5–34.

The Textile Museum gratefully acknowledges the Tarbell Family Foundation of Oregon for a grant enabling color reproduction of this painting.

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Note to contributors

The Textile Museum Journal is devoted to the presentation of scholarship concerning the cultural, technical, historical, and aesthetic significance of textiles. The *Journal* is international in scope with emphasis on geographic areas represented in The Textile Museum collections, which are drawn primarily from Near Eastern, Asian, African, and indigenous American cultures.

Authors are invited to submit manuscripts based on original research of a documentary, analytical, or interpretive nature. Acceptance of manuscripts for publication is based upon peer review. Articles should be both scholarly and accessible to a broad readership.

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The Textile Museum

The Textile Museum is dedicated to furthering the understanding of mankind's creative achievements in the textile arts. As a museum, it is committed to its role as a center of excellence in the scholarly research, conservation, interpretation, and exhibition of textiles, with particular concern for the artistic, technical, and cultural significance of its collections. This mission is pursued through development and maintenance of collections, records, and a library, as well as through scholarly research, exhibitions, publications, and educational programs.

The Museum is open free of charge Mondays through Saturdays 10:00 a.m.–5:00 p.m. and Sundays 1:00 p.m.–5:00 p.m. Closed on legal holidays. The Arthur D. Jenkins Library is open to the public Wednesdays through Saturdays 10:00 a.m.–2:00 p.m and by appointment.

Travellers' Accounts of Mohair Production in Ankara from the Fifteenth through the Nineteenth Century

Gary Leiser

Dedicated to the Memory of
Schuyler V.R. Cammann

"You i' the camlet, get up o' the rail"
Henry VIII, Act V, Scene 4, Line 93

The origin and history of many important textiles that were produced before the modern era are often difficult to trace because of a lack of written documentation. When written records are available, they usually shed light on the economic significance of a textile rather than on where or how it was made. One type of textile for which we are fortunate to have a number of written sources, and even a visual portrayal, concerning both its economic importance and its technological development over many centuries is cloth made from mohair, the hair of the Angora goat.[1]

Based on research in the Ankara religious court archives (*şer'i mahkeme defterleri* or *kadı sicilleri*), two Turkish scholars have recently published work on the significance of mohair to the economic prosperity of Ankara, long the center of its production, in the sixteenth and seventeenth centuries. The data in these archives primarily concern fiscal or legal matters.[2] For technology we can turn to the reports of travellers, mostly Europeans, who visited Ankara between the fifteenth and twentieth centuries. From their varied descriptions of the economic life of the city, we can extract a unique and generally neglected account of mohair. These descriptions are sometimes quite detailed. Together they provide a rich source for our understanding of the technology and the history of mohair cloth in Ankara over a four hundred-year period. They offer a wealth of information about the Angora goat and its products; methods of "shearing" and spinning; processes of weaving, watering, pressing, and dyeing; types and qualities of mohair cloth; the history of the industry and trade.

Origin of the Angora Goat

There was no mohair, of course, without the Angora goat. There are several theories about the origin of this special animal.[3] One theory simply maintains that the Angora goat was a species indigenous to central Anatolia.[4] Another holds that this goat originated in Central Asia and was brought from there to the region of Ankara by nomadic Turkish tribes in the Seljuk period, that is, the twelfth or thirteenth century.[5] Finally, it has been suggested that this goat appeared over time from mutations in ordinary flocks of goats and that it was purposely bred by the Ottomans, beginning in the fifteenth century.[6]

The reason there are so many theories is that the evidence—zoological, archeological, and historical—for the presence of the Angora goat, and textiles made from its hair, in central Anatolia before the fourteenth century A.D. is inconclusive.

Complete skeletons of goats, or any other domesticated animals, dating from prehistoric, ancient, or even medieval times have rarely survived in Anatolia. Furthermore, most bones of a goat resemble those of a sheep. More important, the only way the skeletons of different species of goats can be distinguished is by their horns, which are either straight or curled.

The Indian Drawloom and its Products

Rahul Jain

Introduction

This paper discusses the setup and use of the Indian drawloom as well as the salient characteristics of some of its products from the 17th, 18th, and 19th centuries. Part I describes important technical features of the drawloom and its contemporary use. Part II identifies weave structures and other characteristics of several groups of Indian textiles, using Part I as an analytical frame of reference for determining the use of the drawloom. Emphasis is placed on technical aspects of the drawloom and textiles that have not been discussed elsewhere. Stylistic aspects are also discussed, to the extent that these have not been clearly articulated elsewhere and are deemed important.

The information presented here reflects the preliminary findings of a continuing inquiry into the subject of drawloom weaving in India. The main objectives of this research include documenting contemporary drawloom-weaving conventions in India, determining past techniques and skills, and identifying specific characteristics of drawloom-woven textiles sufficient to place them in a secure technical and historic context. An important motivating factor has been the need to resolve issues of attribution of textiles to India. Many textiles formerly attributed to Iran in recent years have been attributed to India on stylistic grounds. This paper documents observations, suggests hypotheses, and raises questions that merit further investigation. As more textiles are analysed, it is hoped that some of the hypotheses suggested here can be further substantiated or revised in light of new evidence.

It is important to note the following at the outset: First, this paper focuses only on woven textiles. Second, the discussion is limited to weft-patterned fabrics. These are often woven face-down because of the requirements of technique and/or to minimize physical effort on the part of the weavers or their assistants. References to loom setup and weaving thus presume that the fabric is being woven face-down. Third, this paper follows Emery's terminology for describing the simpler weave structures and patterning principles.[1] Discussion of complex weave types follows the terminology prescribed by Centre International d'Étude des Textiles Anciens (C.I.E.T.A.). Fourth, complex weaves that use a separate warp system for binding purposes such as those indicated by the C.I.E.T.A. terms *lampas*, *taqueté*, and *samit*,[2] are referred to in this paper as techniques rather than structures. In general, each of these techniques follows a general guideline for warp and weft control. Variation in technique within this guideline—for example, the order of treadling the binding warp—results in variations in structure. In some cases, a technique may be developed to such a level that it results in a structure significantly different from the original.[3] Finally, two important groups of textiles could not be examined for this paper: these include patterned velvets and textiles woven in a *lampas* technique.[4] This omission prevents a fuller understanding of the use of the drawloom in preceding centuries.

Part I: The Indian Drawloom

Loom technology serves as a good indicator of the existing level of technical, mechanical, and mathematical skills in the weaving profession. The use of drawlooms, for example, presupposes not only the basic knowledge of stretching out a warp and creating a shed, but very often also the understanding of complex weave structures, pattern harness mechanics, multi-shaft tie-ups, intricate shed sequences with multiple warp systems, and, not least of all, the mathematics of

repeating patterns. With its extensive coverage over time and geographic space, drawloom weaving provides a sound basis for comparing the level of technical sophistication in the craft across cultures.

The theory and practice of drawloom weaving are touched upon in this paper to the extent necessary for the purposes of discussion.[5] In principle, drawloom weaving involves two harnesses operating independently on the same warp. The pattern harness is some sort of permanent or semi-permanent mechanical arrangement that allows a helper to "draw" or pull up pattern sheds that normally repeat across the width of the fabric. The structure harness comprises a set of shafts in front of the pattern harness for creating the basic structure of the fabric. The warp ends are entered into both harnesses in a manner that allows the pattern harness to open pattern sheds through the structure shafts, *i.e.*, unhindered throughout the length of the loom.

The Indian drawloom has been described and discussed by several scholars and researchers.[6] Existing studies, however, document neither the unusual technical capabilities of its pattern harness nor the exact tie-up and operating mechanism of its structure harness for specific fabrics. The attempt here is to identify these important technical features not adequately addressed in earlier studies.

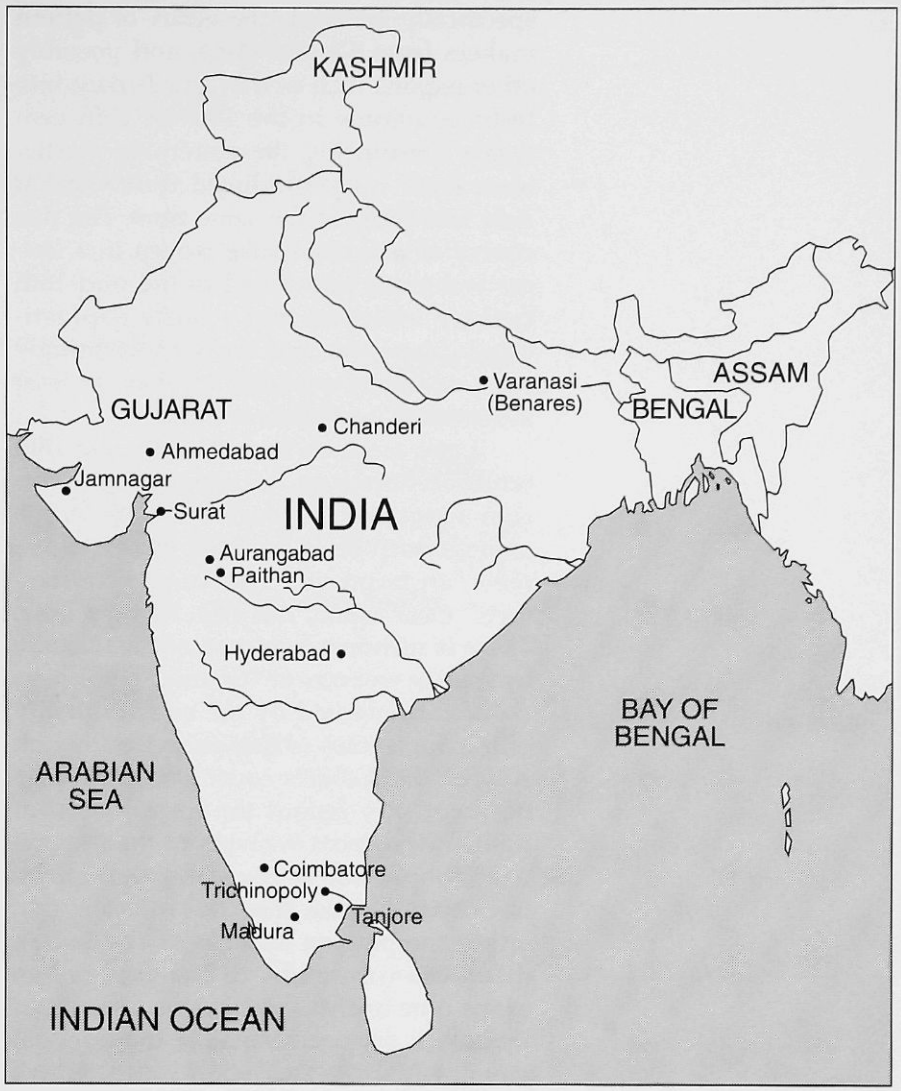


Fig. 1. Map of India.

Origins of the Indian Drawloom

The history of the Indian drawloom—as also that of most of its products—is rather obscure. In general, historical references to "brocades" and textiles embellished with yarns of precious metal, or paintings depicting patterned fabrics from the pre-Mughal period (*i.e.*, prior to the mid-16th century), do not tell us if a complex patterning mechanism was needed to weave such textiles. Establishing the use of such a mechanism is made even more difficult by the fact that India has a rich tradition of woven textiles in which elaborate motifs are laboriously hand-picked. Whether the 14th century court workshops of Mohammad Tughluq used drawlooms to weave "golden tissues," for example, although generally accepted, remains pure conjecture. Possibly the earliest, if cryptic, reference to what may have been a complex technique is made by Nizam-al-Din Mahmud Kari, a 15th century Iranian author, who noted the importation from India of several types of fabrics including "the two-warp manufacture of the court."[7] Similar references suggesting complex techniques are made by other 15th century travellers and historians to specific textiles woven in Gujarat, Kashmir, and Bengal (fig. 1, map).[8]

Tradition in Varanasi, the principal drawloom-weaving center since the 19th century, indicates a 14th century link between India and Central Asia. Scholars, however, have recounted this tradition in slightly different versions. One interpretation traces the art of tying patterns on this particular type of drawloom to a 14th century master of Bukhara. Another version

specifically mentions the influx of pattern makers from Central Asia, and possibly other regions such as Iran and Turkey, into India sometime in the 14th or 15th centuries. Presumably, the patterning mechanism itself was introduced from Central Asia into India at the same time. The discovery of patterned silks woven in a *lampas* technique and dated to the mid-16th century indicates that a fairly sophisticated drawloom and weaving technique were definitely available by then, at least in Assam in northeastern India.[9]

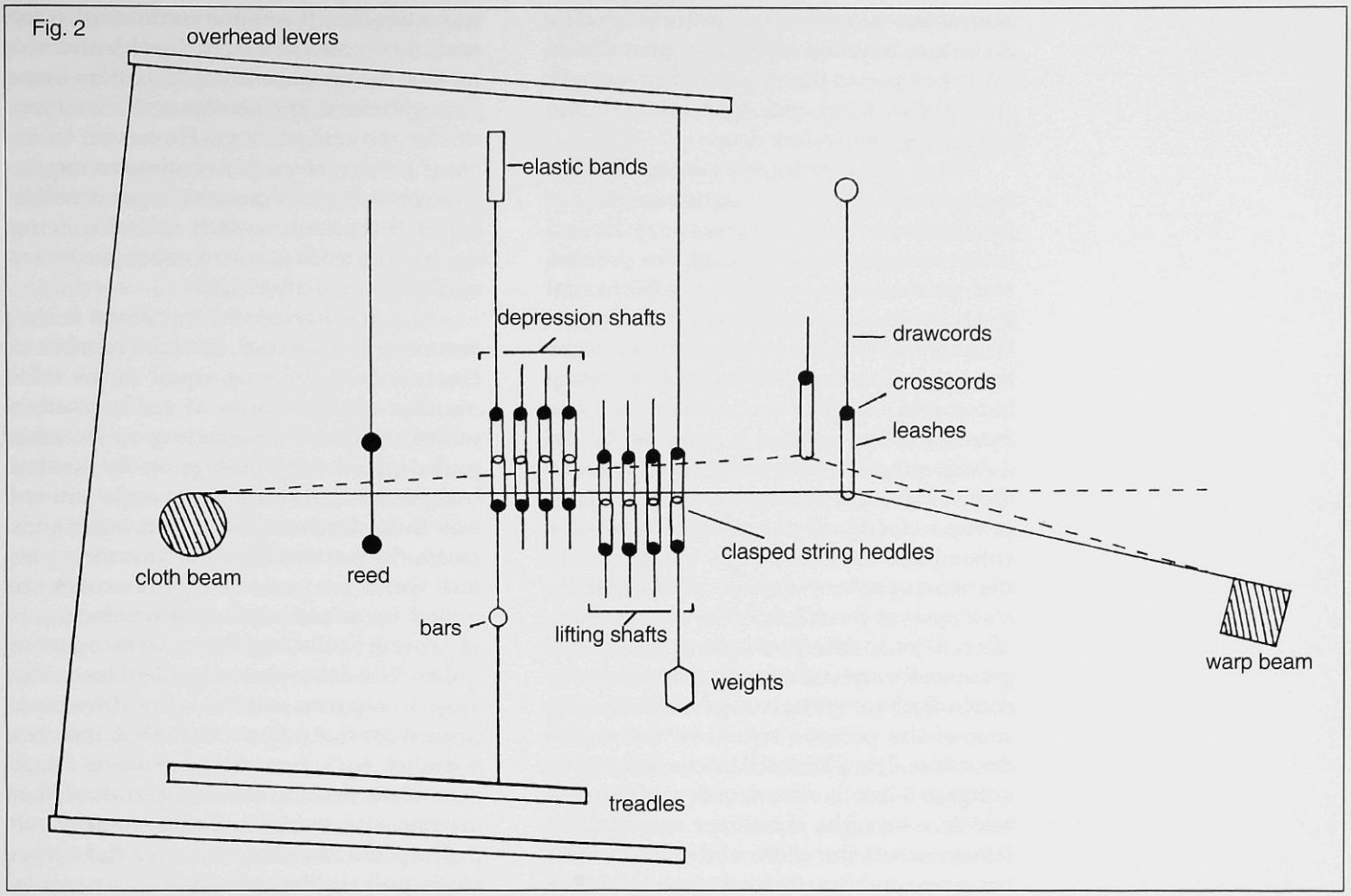
Later accounts from the 16th and 17th centuries document the importation of foreign masters to the Mughal ateliers for the express purpose of teaching Indian craftsmen "an improved system of manufacture." Once again, this tells us very little. There is mention, however, of the mastery by Iranian weavers of "figured" textiles—a claim corroborated by the superb quality of Iranian textiles of that period. Although Abu'l Fazl, Akbar's court historian, does not explicitly record the importation of Iranian drawloom weavers to the Mughal workshops, this is generally thought to have been the case. If so, this indicates that either the pattern harness of the Indian drawloom was similar to that used in Iran at the time or that the Iranians introduced their own pattern harness at the imperial workshops. On the other hand, Abu'l Fazl's mention of imitations of Turkish, European, and Iranian textiles produced in Gujarat[10] supports the hypothesis that complex looms and techniques were already known in India. The importation of foreign weavers to the Mughal workshops therefore was probably an effort to produce locally high quality textiles that could match those woven for the Iranian or Turkish courts.[11]

Descriptions and photographs of the Iranian drawloom in the 20th century show its pattern harness to be identical to that of the Indian drawloom.[12] There is little reason to suppose that this type of pattern harness changed much over the centuries either in Iran or in India. The possibility that the Indian drawloom is derived from an Iranian prototype cannot be ruled out, although this probably occurred before the Mughal period. On the other hand, if the Indian drawloom is derived from Central Asia, it is possible that nearly identical drawloom types were in use in the three contiguous areas of Central Asia, Iran, and India.

The Contemporary Drawloom of Varanasi

Today, the drawloom used in Varanasi differs in two important respects from the traditional loom used elsewhere in India. Unlike the latter, the Varanasi loom has a warp beam (*tur* or *turia*). This is either round or has a curious four-sided cross-section (fig. 2) and is engaged by a rudimentary ratchet-and-pawl system. Warp let off, therefore, is in discrete lengths (as is also the case in the traditional loom) and maintenance of uniform tension in the length direction depends entirely on the skill of the weaver. In these respects, the Varanasi drawloom also differs from the Iranian drawloom, photographs of which show two warp systems at different levels, each carried separately over a bar and freely weighted by sand bags. The use of sand bags is a simple device but reflects a more sophisticated principle of warp control. Warp let off is smoother, and constant tension is maintained in the length direction at all times (that is, when the warp is at rest and when foundation or pattern sheds are open).

The second distinguishing feature of the Varanasi drawloom is the use of a simple jack-type mechanism for the structure shafts (*kandhi*). By contrast, the traditional Indian loom usually employs a counterbalance mechanism. In Varanasi, each lifting shaft is pulled up by the action of an overhead lever activated by a treadle. Depending on the number of shafts that must be lifted for each shed of the foundation weave, each lever may be activated by its own treadle, or groups of levers may be connected to different treadles. The lifting shaft descends to its resting position by means of weights (*langar*) hung from its lower bar. Each depression shaft in turn is pulled down by its own treadle (*paonri*). Instead of being connected directly to the lower bar of the depression shaft, this treadle is connected to a horizontal bar (*paosar*) hung from the depression shaft. Excessive shaft sway that may result from a direct connection of the treadle to the shaft is thus avoided. The depression shaft rises to



its resting position by means of an elastic band tied from its upper bar to an overhead support.

It is not clear to what extent this jack-type mechanism is a modern innovation. The use of elastic bands for raising depression shafts, for example, is obviously a modern convenience. While changes in the physical structure of the loom are known to have been made in the 20th century, its exact original form cannot be determined from available documentation. The Iranian drawloom, by contrast, appears to have utilized a counterbalance-type mechanism well into the 20th century.

The fragile appearance of the Indian drawloom has led to the notion that it is not suitable for weaving heavy fabric. This is incorrect. Supports for both cloth and warp beams are dug well into the ground, providing a framework more rigid and stable than that of the sturdiest of wood frame looms. The addition of a suitably heavy beater should suffice for weaving heavy fabric.

Fig. 2. The Indian drawloom (profile).

The Pattern Harness

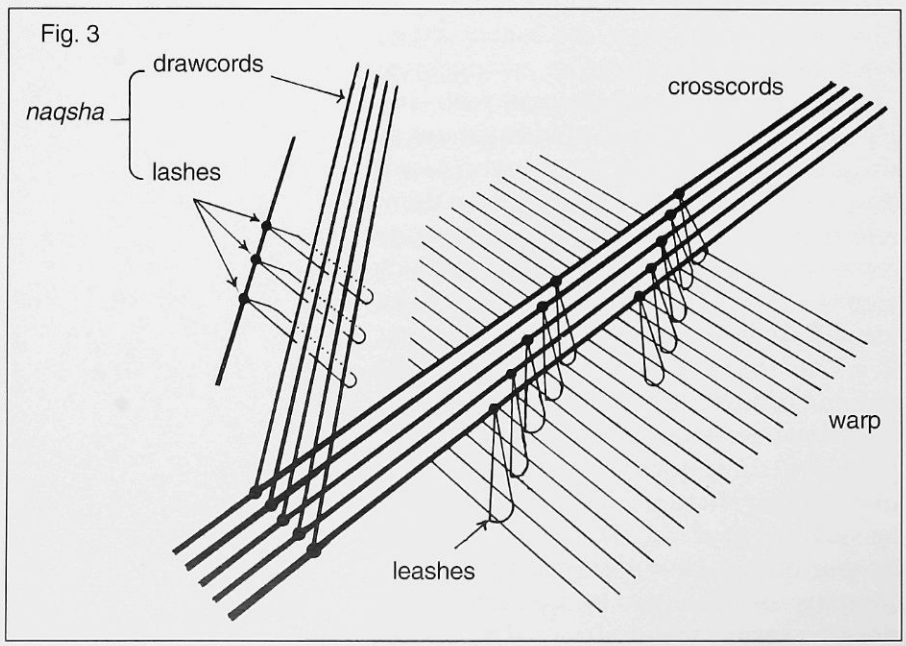
The pattern harness of the Indian drawloom consists entirely of an arrangement of horizontal crosscords (*paggia*) with simple, string leashes (*naka*) to hold groups of warp ends and vertical drawcords (*naqsha dori*) with string lashes (*kheva*) for pattern selection (fig. 3).[13] All four components are connected together entirely by knots. Such a construction, needless to say, makes for virtually noiseless operation.

This type of mechanism can be thought of as a pattern shaft harness—each horizontal crosscord being a pattern shaft, but taking up very little space as compared to one made of a rigid, less divisible material such as wood.[14] A 17th century German treatise on weaving documents the use of as many as 500 shafts in the pattern harness of large drawlooms.[15] The use of

numerous wood-frame pattern shafts, doubtless, required a loom of great depth. A bank of two to three hundred crosscords, on the other hand, may be made to fit into a space less than a foot deep.

Each crosscord has as many leashes hung from it as there are pattern repeats in the fabric width. The leashes may be tied to the crosscords in a straight or pointed arrangement.[16] The warp is at a horizontal level between the cloth beam and the pattern harness but then slants down toward the ground in the direction of the warp beam (fig. 2). The upward pull of the crosscords and leashes is matched by the downward pull of the warp and this holds the leashes and crosscords taut. Usually groups of two or more warp ends are entered into each leash, this number being the warp pattern step (C.I.E.T.A. term: *découpure*) of the fabric.[17] The total number of crosscords determines how many such groups of warp ends can be independently controlled for patterning—broadly, the size of the pattern repeat in the width direction. The pattern harness illustrated in figure 3 has five crosscords with leashes tied in a straight repeat for two pattern repeats across the width of the fabric. With two warp ends entered into each leash, the warp pattern step is 2 and the pattern may be a maximum of five warp pattern steps wide. In general, the finer the warp pattern step (*i.e.*, fewer the number of warp ends entered into each leash) and the greater the number of warp pattern steps per centimeter, the smoother the contours of the woven pattern. However, more warp pattern steps per centimeter require a larger number of crosscords per centimeter of the pattern width. All else being equal, therefore, more crosscords are needed for wider patterns.

Fig. 3. The pattern harness.



To each horizontal crosscord is tied one vertical drawcord, the total number of crosscords thus being equal to the total number of drawcords. If a drawcord is pulled up, the corresponding crosscord is pulled up, in turn pulling up the leashes hung from it and the warp ends entered into those leashes. The raised warp ends create the pattern shed for inserting pattern wefts. For patterning, drawcords are pulled up selectively and this selection is obtained by lacing them with a set of lashes. The draw-person[18] pulls a lash sideways to separate out the set of drawcords needed for that pattern weft shot, inserts a wooden fork (*mantha*) between those drawcords that are selected and those that are not, and twists it around to grip and pull up the selected ones. As the drawcords pull up the appropriate crosscords, the weaver inserts one or two angle hooks (*ankda*) under the latter. This equalizes the pattern shed across the width of the warp and keeps the shed open for inserting the pattern weft (thus relieving the draw-person of the lift).

All else being equal, the size of the pattern repeat in the length direction depends on the number of lashes. In most cases, one lash is needed per color for each horizontal line of pattern—*i.e.*, the weft pattern step is 1. In some instances, however, the same lash must be pulled (and thus the same set of drawcords lifted) two or more times in succession in order to square the pattern units—*i.e.*, the weft pattern step is 2 or more.

The drawcords and lashes of the pattern harness together comprise a detachable module called *naqsha* (referred to as such in this paper for want of an exact English translation). The *naqsha* defines the width (in number of warp pattern steps) and length (in number of pattern weft rows) of a single technical repeat unit of

the pattern. Traditionally, the *naqsha* component of the pattern harness was prepared off-loom by a distinguished class of pattern makers called *naqshaband*. The origin of the art of *naqsha* making, therefore, cannot be separated from the development of this type of pattern harness itself. It is for this reason that the tradition of the Indian *naqshaband* tracing their art and/or ancestry to Central Asia may be interpreted to mean that this pattern harness itself has a Central Asian origin. On the other hand, the Indian terms *naqsha* and *naqshaband* are of Iranian origin and are identical, or nearly so, to their Farsi counterparts, pointing to the possibility of an Iranian origin for this pattern harness.

It should be pointed out that the preparation of the *naqsha* is not nearly so esoteric as is sometimes presumed. The drawcords are stretched out vertically on a rectangular frame and each lash is laced in horizontally to go under the drawcords required to lift for that pattern weft row and over all the others. If, for example, in a set of 10 drawcords, nos. 4, 5, 6, 7, and 8 need to be raised for a pattern weft shot, the lash would be laced in to go over nos. 1, 2, and 3, then under nos. 4, 5, 6, 7, and 8, and over nos. 9, 10. If a binding point is to be inserted in the center of this weft shot to avoid a long pattern weft float on the face of the fabric, the lash may be made to skip No. 6 (*i.e.*, go over it). By contrast, in the case of complex techniques such as *lampas* or *taqueté* that use an altogether separate warp system to bind the pattern wefts in a regular order, there would be no need to insert any binding points in the pattern. The two ends of each lash are knotted together onto a separate string (*nathia*) to keep all the lashes in proper sequence. Once the *naqsha* is prepared, it is removed from the frame and the drawcords are simply knotted on to the crosscords of the loom. Likewise, the drawcords are easily untied from the crosscords and the *naqsha* can be stored for future use.[19]

The most important feature of this type of pattern harness is its immense flexibility. There are no rigid, immoveable parts, and, as mentioned above, setting up the harness involves little more than tying together cords and strings. This endows it with at least three advantages over the better-known comberboard harness with lingo-weighted harness cords, as used in the fully developed European (and presumably Chinese) drawloom as well as with the modern jacquard:

First, the warp density (*i.e.*, warp count, or number of warp ends per centimeter) may be varied at will as the existing leashes can be untied from the crosscords and re-tied over a new warp with remarkable ease.[20] If the number of crosscords remains unchanged, a new warp with more ends per centimeter would result in a smaller pattern repeat width if the leashes are retied with the same number of warp ends entered into them as before. The width of the repeat is unchanged if the number of warp ends entered into each leash is increased in proportion to the increased warp density.

Second, easy manipulation of the pattern harness components also allows variation in the width of pattern repeats both from one warp to the next as well as within the same fabric. Thus, wider pattern repeats may be obtained simply by adding more crosscords and leashes to the existing set and re-tying the original leashes to accommodate the new repeat size and arrangement. An advanced application of this feature, as discussed below, is found in the use of two or more pattern repeat systems with different repeat widths side-by-side in the same textile.

Third, the direction of one or more repeats of the pattern can be changed during the course of weaving by untying the corresponding set of leashes and retying them to the crosscords in the reverse order. A row of detached motifs facing one direction, for example, can be made to face the other direction in the next row either selectively or across the fabric width.[21] In general, depending on design requirements, the direction of repeats can be changed freely at any point in the weaving either in the width or length directions. As discussed below, this feature, usually combined with the previous one, has been used with great ingenuity by Indian weavers.

This flexibility in warp density and in width and direction of pattern repeats is, for all practical purposes, impossible to

obtain with the harness of the European drawloom or the modern jacquard. The comberboard harness has unwieldy wood, metal, and cord components integrated into a more or less fixed arrangement. While warp densities may be marginally varied within the existing configuration, once the harness is set up for a particular pattern repeat width and direction, it is excessively costly in time, labor, and resources to dismantle it and set it up for a new set of fabric and design parameters.

Treadle-operated jacquards[22] have mostly replaced the *naqsha* as a pattern selection device in Varanasi. That their use results in a substantial saving in time and labor over the preparation and use of *naqsha* hardly needs mention. In addition, the basic setup of the drawloom has remained unaltered. The jacquard head is used with the traditional crosscord-drawcord arrangement, with each hook directly attached to one drawcord and, thus, one crosscord. The selection of hooks by punched cards is, therefore, analogous to the function of lashes and does away with the need for a draw-person. Most importantly, in using the jacquard in this unconventional manner (*i.e.*, without the usual comberboard harness), all the advantages of the Indian pattern harness discussed above are retained.

Using the jacquard instead of the *naqsha* does have some limitations which, although by and large insignificant, are still worth noting. First, the jacquard head, being manufactured in discrete sizes (*i.e.*, number of hooks), imposes a specific limit on the maximum number of crosscords that can be used for patterning. The use of the *naqsha*, on the other hand, allows the number of crosscords to vary freely. However, as discussed below, drawloom woven Indian textiles, whether historical or contemporary, have seldom needed more crosscords than can be controlled by the jacquard heads available today for handweaving purposes.[23]

Second, if the weft pattern step is 2 (or more), two (or more) cards must be cut and laced into the card chain for each pattern weft row. In the case of the *naqsha* or any other drawloom harness, by contrast, the same lash can be pulled as many times as necessary. A weft pattern step other than 1, however, does not occur in any of the Indian textiles examined for this study.

Third, in certain textiles, two or more different patterns may be brocaded[24] side-by-side, with each pattern requiring all, or nearly all, of the available crosscords.[25] This is easily accomplished with any drawloom harness, each pattern requiring its own set of lashes laced into the drawcords.[26] A lash from each set is pulled in sequence and, although the pattern sheds for each set repeat across the width of the fabric, brocading is done selectively to accommodate the different patterns side by side. As discussed below, this flexibility in pattern selection has been taken to considerable heights by Indian weavers in the case of certain 19th century textiles. In the case of the jacquard, on the other hand, if patterns A, B, C, D are being brocaded in succession side by side, the punched cards for every pattern must first be separated and then rearranged and laced together to follow the A, B, C, D brocading sequence. A similar situation arises when two (or more) patterns are superimposed on each other, as, for example, in the case of some 17th and 18th century textiles discussed below that have supplementary-weft patterns brocaded on a patterned damask foundation. The use of the jacquard in such cases, while less convenient, is quite feasible.

In general, therefore, the notion that the use of the jacquard with the Indian drawloom is in itself the cause of deterioration in product quality reflects a lack of understanding of drawloom-weaving principles, the advantages specific to the Indian pattern harness, and the ingenious adaptation of the jacquard mechanism for use with this type of harness.

Problems in terminology also need to be addressed. The entire pattern harness, *i.e.*, crosscords, drawcords, leashes, and lashes, is sometimes loosely referred to as *jala*, literally, "a network of threads." At other times, however, the term *jala* is applied specifically to the *naqsha* component of the harness. Several variants of this pattern harness are used elsewhere in India. One variant, for example, has no drawcords and the pattern selection is made directly on the crosscords. Such variants are also referred to as *jala* or are given

regional names. Replacing the draw-person and lashes with jacquards, while the remainder of the traditional harness remains intact, has further confounded the question of what the term *jala* exactly refers to in contemporary usage.

The Structure Harness

Unlike the pattern harness which remains largely invariant in function, the setup and use of the structure shafts in a drawloom can vary considerably depending on the choice of weave structure. It should be pointed out that clasped string heddles (*bai*), as a rule, are used in the structure shafts. In the case of lifting shafts, the warp ends are always entered above the clasp. For depression shafts, the warp ends are always entered below the clasp.[27]

Figures 4 and 5 illustrate the two principal ways in which the structure shafts of the drawloom are set up in Varanasi today. There are, of course, variations in either category resulting in minor differences in structure, but these do not fundamentally alter the weaving technique.

Figure 4 shows two different setups for patterning a plain weave fabric that is commonly used for saris and yardage. The use of two lift and two depression shafts for a plain weave foundation might seem odd. However, a demonstration showed that simply raising every other warp end by means of a lifting shaft did not clear the shed as the remaining warp ends had a tendency to stick and rise with the first half. It was necessary to use a depression shaft simultaneously to prevent these remaining warp ends from rising and obstructing the shed.[28] The weavers pointed out that the warp is kept at less tension in the case of plain-woven fabrics as compared to satin-woven fabrics. Moreover, because only one in five warp ends need to be lifted for a 4/1 satin foundation weave, "stickiness" is much less of a problem with higher tension.[29]

Setup A (fig. 4a) is commonly used for patterning a plain weave foundation with continuous or discontinuous supplementary wefts. Binding points for these supplementary wefts are designed into the pattern itself. Therefore, when pattern sheds are opened, the weaver need only insert the supplementary weft without having to separately treadle any depression shafts for binding.

Setup B (fig. 4b) is generally used in Varanasi for what is called "cutwork", presumably a speeded-up, drawloomed imitation of the exquisite plain-woven cotton *jamdani* in which elaborate motifs were traditionally hand-picked and inlaid with discontinuous supplementary wefts. The

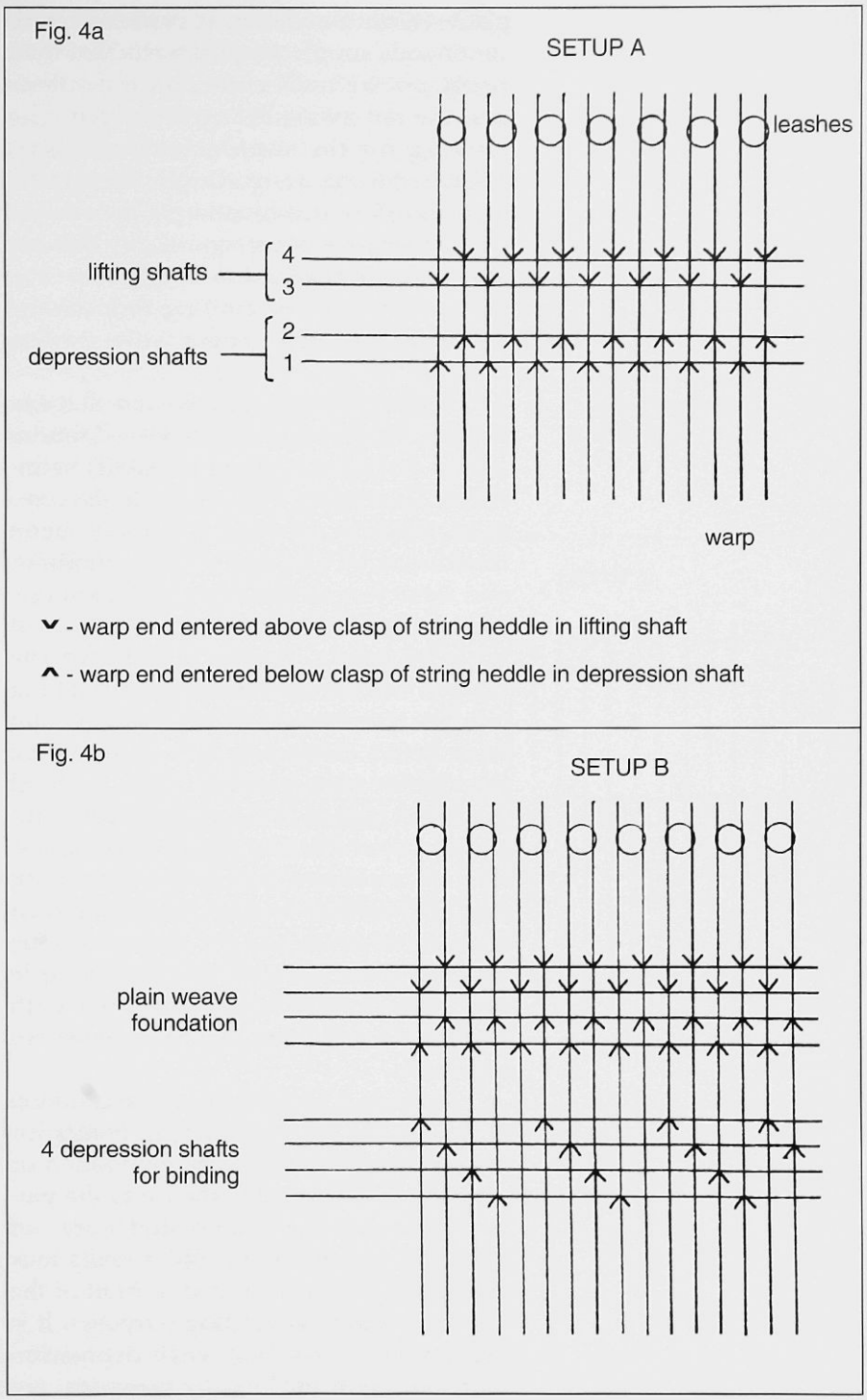


Fig. 4. Loom setups for patterning a plain-weave foundation. (a and b)

plain-weave foundation is patterned with continuous supplementary wefts that float freely on the underside and are subsequently cut away, hence the name. The binding for the supplementary wefts, instead of being designed into the pattern, is provided by treadling in plain-weave or twill order four depression shafts that are added in front of the four plain weave shafts. This type of binding reduces the risk of the sheared pattern wefts fraying with use.

Figure 5 shows two setups that are used for various kinds of patterned fabrics with a 5-shaft (sometimes 8-shaft) satin-weave foundation. These include the common *tanchoi*, thought to have been introduced by Chinese weavers in Surat, and now woven for saris and yardage. Also included in this category are most types of *gyasar*, woven mainly for the Tibetan market for ritual and furnishing use. The structures of these fabrics fall into three broad categories: (1) a satin-weave foundation with multiple wefts, with all (or all but one) of the wefts used individually to pattern the face (C.I.E.T.A. term: *liseré*); (2) a satin-weave foundation with multiple wefts as in (1), further patterned with continuous and/or discontinuous supplementary wefts; and (3) a simple satin-weave foundation patterned with continuous and discontinuous supplementary wefts.

In setup A (fig. 5a), the more common of the two by far, the binding points for the pattern wefts (whether foundation or supplementary) are designed into the pattern itself and depression shafts are not necessary. In setup B (fig. 5b), usually four depression shafts are added in front of the five satin shafts for binding purposes. It is interesting to note that when depression shafts are used for binding purposes, not all foundation warp ends may be entered into these shafts. Usually only every second or third warp end is entered into the depression shafts, thus increasing the length of pattern weft floats on the face of the fabric. The difference in warp take-up between those warp ends that are used for binding and those that are not is apparently not a problem.

All the above setups are used with a single warp system. Therefore, in all cases, pattern wefts are bound on the face of the fabric where necessary by foundation warp ends. There are, however, some looms in and around Varanasi that still weave *gyasar* in a *lampas* technique with two warp systems. The setup for one such loom is shown in figure 6. The 8-shaft satin-weave foundation of the *lampas* fabric, set at over 120 ends per centimeter, is woven with eight lifting shafts. In front of the satin shafts are added four lifting and four depression shafts to work the separate binding warp in a regular 1/3 twill. The proportion of the binding warp ends to the foundation warp ends is 1:8.

In all cases, the number of warp ends entered into each leash of the pattern harness always equals the number of warp ends entered into each dent (*ghar*) of the reed (*phanni*). Thus, for fabrics with a plain-weave foundation, two warp ends are entered into each leash (warp pattern step of 2) and each dent. For satin-woven fabrics, usually five warp ends are entered into each leash (warp pattern step of 5) and dent. In the case of the *lampas* fabric, eight foundation warp ends (warp pattern step of 8) plus one binding warp end were entered into each leash and dent. Weavers insist that this manner of entering the warp is essential for obtaining clear pattern sheds.

As is clear from the preceding discussion, pattern wefts are bound to the foundation weave in two different ways in techniques that use a single warp system. In some cases, depression shafts are used for binding and the pattern wefts are bound down regularly by single (foundation) warp ends. When fine silk warps are used, such binding ends do not appear prominent and, therefore, allow the heavier pattern wefts to show prominently. In most cases, however, the binding points are designed into the pattern itself. This shifts part of the work from the weaver to the *naqshaband* (or the jacquard designer and card puncher). Although the weaver must still insert the pattern wefts, there is no need to treadle a separate binding sequence of depression shafts (in addition to the treadling of the structure shafts for the foundation weave). Designing the binding points into the pattern, however, causes pattern wefts to be tied down at

each binding point on the face by as many warp ends as are entered into each leash (*i.e.*, the warp pattern step, which is usually two or more). For an equivalent length of pattern weft float, therefore, designing the binding points into the pattern suppresses the pattern wefts to a greater degree than would the single warp end binding produced by treadling depression shafts. Designing binding points into the pattern does allow them to be freely laid out, and this may be used to advantage in delineating pattern details. More often, however, their excessive use tends to break up and mar the overall design.

More sophisticated patterning principles are incorporated in complex techniques such as *lampas* and *taqueté/samit* which use a separate warp system for binding. Because the foundation warp is not used for binding down pattern wefts at any point, this permits maximum clarity of pattern outline. The low density of the fine binder warp relative to the denser foundation warp and the single warp end binding in *lampas*, for example, show the relatively heavy pattern wefts to great advantage. Together with an independently tensioned binder warp system, these features of the technique may be used in a manner that allows the pattern wefts to appear in relief over the foundation fabric. More generally, the use of two separate warp systems allow the face of the foundation weave to be contrasted with the face of the binding weave.

Part II: The Textiles

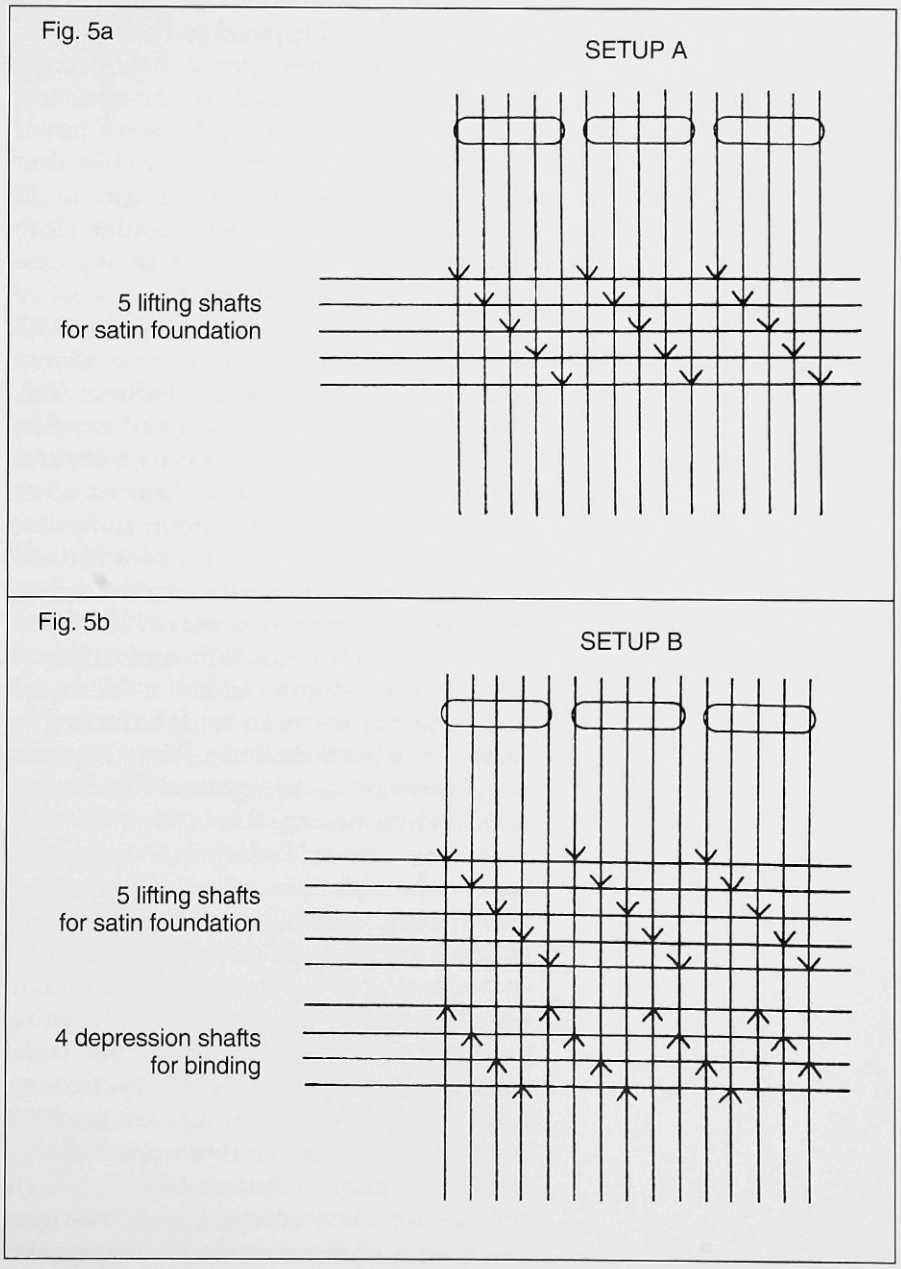
The discussion in this part of the paper is based on technical analyses of Indian and Iranian woven textiles in the collections of the Philadelphia Museum of Art, The Textile Museum (Washington, D.C.), the National Museum (New Delhi), the A.E.D.T.A. (Paris), the Paley Design Center at the Philadelphia College of Textiles, and the Calico Museum of Textiles (Ahmedabad), in addition to published analysis and documentation of related textiles.

General Differences between Indian and Iranian Textiles

Important technical and stylistic features distinguish a wide range of Indian textiles from visually similar Iranian textiles of the 17th and 18th centuries:

Metal-Wrapped Yarns: The first and most important distinguishing feature appears to be the nature of metal-wrapped yarns. Technical analyses of nearly 110 metal-woven textiles attributed to India showed consistently the gilt metal and silver foils to be wrapped in the Z-direction over yellow (or yellow-orange) and white silk, respectively. Analyses of over 200 metal-woven textiles attributed to Iran, on the other hand, revealed the two types of metal foil to be wrapped in the S-direction

Fig. 5. Loom setups for patterning a satin-weave foundation. (a and b)



in every case. Supporting this hypothesis is technical information presented in the Textile Museum's 1987 exhibition catalog[30] of Iranian textiles in which metal foils are wound in the S-direction over silk in all but one case. The single exception is a robe (cat. no. 69, TM 1972.24.3) stitched from a textile the technical characteristics of which in any case suggest a western Indian attribution for the fabric.[31] It is important to point out that several textiles tentatively attributed to India in the catalog should be reassigned to Iran on this basis. Of these, both cat. no. 52 (TM 3.95) and cat. no. 53 (TM 6.262) have a 1Z3 twill-weave foundation patterned with weft substitution. The complex technique of cat. no. 54 (TM 3.96a) is possibly derived from *samit*[32] and does not appear in any of the Indian textiles examined. In all probability, such advanced techniques were never used in India. The fourth textile that should be reassigned to Iran is cat. no. 57 (TM 3.131), a controversial double cloth whose stylistic features have in any case defied a definite attribution.[33]

In general, in the case of 17th and 18th century metal-woven textiles that are not clearly attributable to either India or Iran, the direction of the metal foil may be sufficient to confirm or reject an attribution made otherwise on stylistic or other grounds. One important group comprises patterned velvets, several of which in recent years have been attributed to Mughal workshops. Analyses of 12 velvets dated to the 17th and 18th centuries and attributed to Mughal India[34] confirm the use of metal wefts in which the foil is wrapped in the Z-direction over silk yarn.

Contrary to the opinion that metal-wrapped yarns, together with other raw materials, were traded over long distances, the difference between the Indian and Iranian yarns suggests independent, stable production concentrated in a few local centers. It may also reflect a minor difference in the technology employed to produce such yarns in India and Iran. One would expect this distinction to apply to the entire range of textiles embellished with metal-wrapped yarns, including carpets and embroideries. In this respect, it is worth noting that in a discussion of the so-called "strapwork" carpets, Eiland suggests an Indian provenience for a group of metal-brocaded Indo-Herats.[35] He notes that "the metal thread is wound differently" in these carpets, as compared to the metal-wrapped yarns used in the Polonaise type woven in Iran. Published analyses of Polonaise carpets show the use of metal wefts with S-wrapped foils.[36]

The situation is less clear in the case of 19th century Indian textiles. Watson's *Collection of Specimens of the Textile Manufactures of India,* issued in 1873, includes swatches of over 70 textiles woven with metal-wrapped yarns.[37] Specimens from the most important drawloom-weaving centers such as Varanasi, Ahmedabad, Aurangabad, and Hyderabad, show the foils consistently wrapped in the Z-direction. There are, however, five examples that show the foils to be wrapped in the S-direction. Even more significantly perhaps, these exceptions are sourced from Kashmir or centers in South India (Tanjore, Trichinopoly, Madura, Coimbatore).

Use of Cotton Wefts: A second important feature, as discussed below, is the widespread use of cotton wefts in several important groups of 17th and 18th century "silk" textiles attributed to important drawloom-weaving centers such as Ahmedabad and Surat in Gujarat. The use of cotton yarns in imperial quality "silk" textiles does not appear to be a feature of the Iranian silk-weaving tradition of that time. Although there are some later examples of Iranian brocaded satins woven with cotton wefts, the vast majority of simple, brocaded plain weaves and satins from that region feature silk warps and silk wefts.

Design Principles: A third difference between the Indian and Iranian textiles concerns the design principle underlying the use of straight (as distinct from point) pattern repeats. Large numbers of textiles from both regions feature offset rows of detached, repeating floral motifs. In keeping with a more formal design sensibility, the straight repeats in the Indian textiles almost never vary in direction. Although the repeats sometimes vary in color, the color changes tend to follow a pre-determined rule.

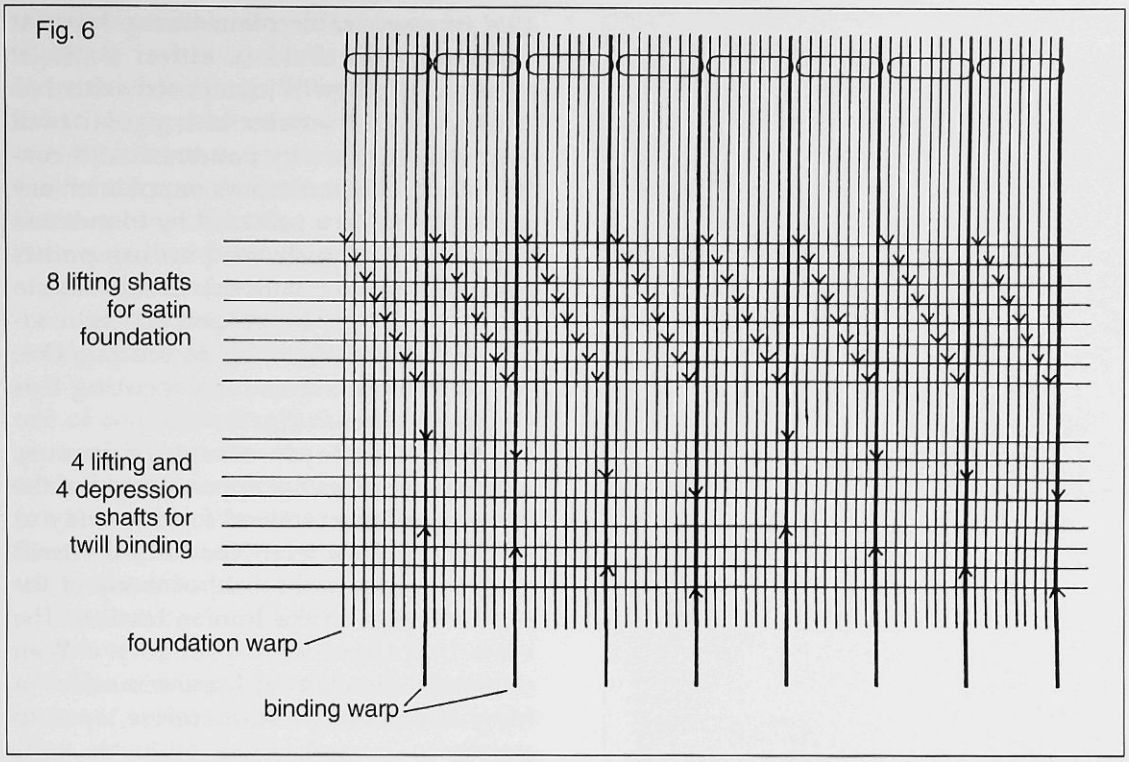


Fig. 6. Loom setup for *lampas*.

The direction of repeats in Iranian textiles, on the other hand, is most often reversed in alternate rows. This is in accordance with the tradition established early in the Safavid era. Pattern repeats in the dense figural compositions seen in many Safavid textiles are normally mirror-imaged along a vertical axis one above the other in order to reverse direction.[38] As in the Indian examples, color changes often follow a pre-determined order.[39]

For the same set of fabric and pattern parameters, the *naqsha* preparation would be different in the Indian and Iranian cases.

As shown in figure 7, the order of interlacing the lashes onto the drawcords in the Indian case is similar for the minimum pattern unit and its offset twin that together comprise the *naqsha* (*i.e.*, a single technical repeat unit). In the Iranian case, the order of interlacing the lashes is different for the minimum pattern unit and its reversed image.

Later 19th century textile specimens collected by Watson in India include some that have offset and reversed repeats. These are from Hyderabad and Tanjore, centers that are known to have been under strong Iranian influence during the Mughal period. Textiles from centers such as Varanasi and Ahmedabad, on the other hand, do not show the use of reversed repeats.

Color Palette: Differences in the color palette of Indian and Iranian woven textiles have generally provided an important means of identification of origin, although formal dye analyses have not been published. Most Indian textiles examined appear to use a deeper and somewhat limited color palette as compared to the more varied colors of many 17th and 18th century Iranian textiles. Iranian textiles of this period often show a very distinctive use of salmon, peach, orange, and citrus tones with cool blue highlights. Some of these colors were originally quite bright and bold but have faded with time.

Sashes and Related Textiles

The first group of textiles comprises sashes (*patka*) as well as a few other related textiles. Most of these are patterned with stock Mughal motifs of flowering plants and floral creepers on a metal-woven background.

Woven sashes dated to the 17th and 18th centuries can be classified by weaving technique into three very different categories. The first two types, discussed

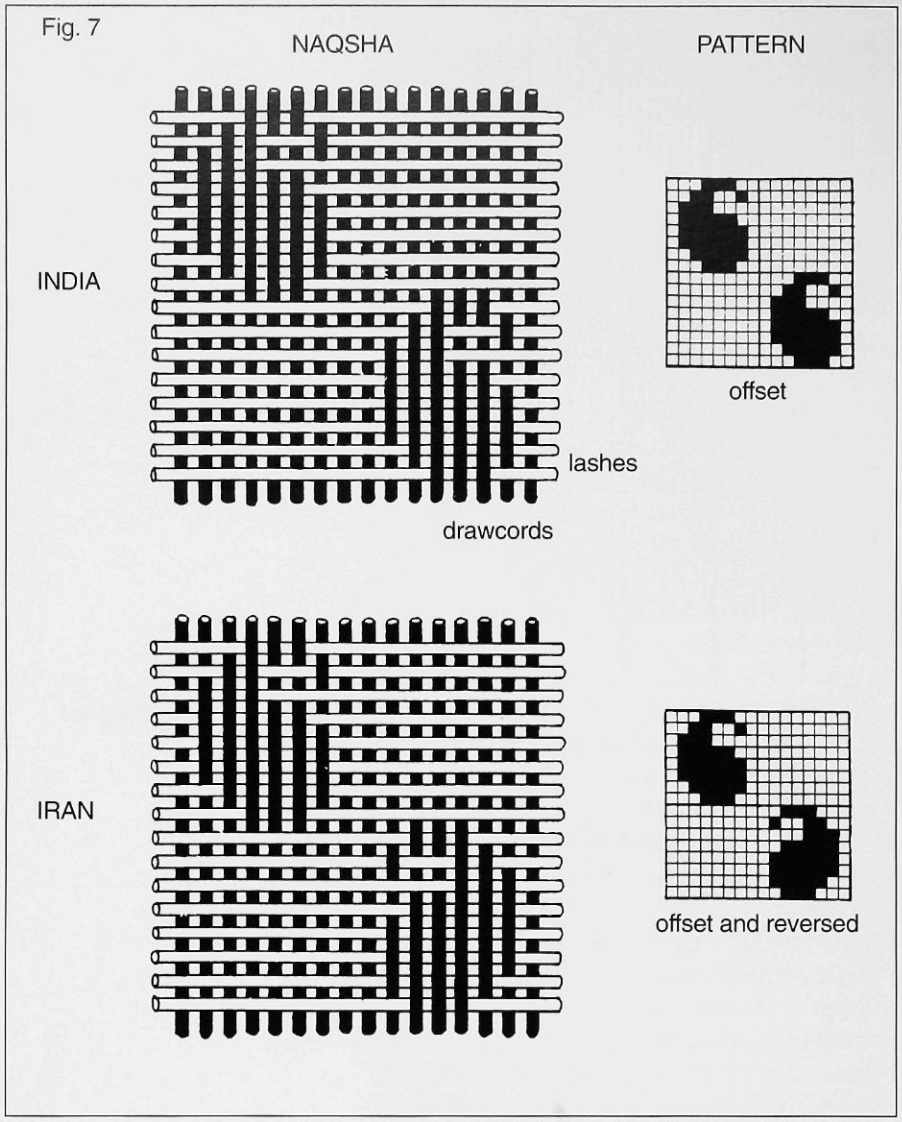


Fig. 7. *Naqsha* preparation in Indian and Iranian tradition.

here, are executed in complex techniques, and are generally attributed to one or more Mughal workshops in Ahmedabad. Their weave structures have been discussed in detail by Sonday and Kajitani.[40] The third type is woven in a tapestry technique associated with centers such as Chanderi and Paithan in central and western India.

Several important features of the first two types of sashes, as well as related textiles, should be noted:

Weave Structure: The first type have their end-panels as well as side- and cross-borders executed in a type of double weave (fig. 8). Broadly, the face is a 1/3 twill-weave patterned with continuous and discontinuous substituting wefts, the continuous substituting wefts being carried in a separable plain-weave layer at the back. The field is either a "twill damask" (3/1 twill juxtaposed with 1/3 twill) or a 3/1 regular or irregular twill weave. It is generally patterned with continuous or discontinuous supplementary wefts (bound in a 1/3 twill by foundation warp ends or with the binding points designed into the pattern). In addition to the sashes, there are at least six sari end-panels[41] executed in this technique. One possible loom setup for executing this structure is shown (fig. 9).

This two-layer structure is very unusual and does not appear in any of the Iranian textiles examined for this study or published elsewhere. Nor does the twill damask found in the field of many of the sashes appear in the Iranian textiles. The view that these were probably woven under the direction of Iranian masters in Mughal workshops is, therefore, open to question.

Curiously, a very similar structure and technique appears in some 19th century European shawls.[42] These have two layers of plain weave, but the layer on the back has only half as many warps as the layer on the front. As in the Indian examples: (1) the front layer is patterned with weft substitution, the pattern wefts being free-floated at the back (rather than between the two layers) when not in use; (2) the foundation weft of the back layer is used as a continuous substituting weft to pattern the front layer, the back warps remaining unwoven where this is the case; (3) the central field is woven in a single layer incorporating warps from both layers of the patterned areas.

Other than the presence of two separable layers, this structure has little in common with the type of double cloth in which patterning is achieved by a complete interchange of the two layers. The patterning principle here is weft substitution. Contrary to the notion that this two-layer technique is very complicated,[43] it is actually simpler than double cloth in both concept and drawloom execution. In the case of the sashes, the difficulty lies not in weaving the end-panel in two layers, but in weaving the side-borders in two layers together with the adjacent field in a patterned damask.

One possible reason for weaving two separate layers could be the need for a more flexible fabric. With the continuous substituting wefts carried in a separate layer (rather than in an integrated structure of the complementary-weft type) and the metal wefts floating at the back when not needed for patterning the face, a more supple fabric was achieved. On the other hand, the subsequent starching and calendering of the sashes suggest that flexibility was not an important consideration. The use of continuous substituting wefts in a separate layer (when the weaver could just as well have used only discontinuous ones for the same visual effect) also adds weight to the sash end-panel, essential for the Indian manner of tying, and provides a protective backing to the metal-woven front layer.

The consistency of technical characteristics of these sashes is striking. Apart from structure and technique, other features such as warp counts, warp pattern step, selvedges, and choice of yarns show no significant variation. Even the direction of the twill binding on the face was found to be the same in all but one case. While the sashes are dated by style from the late 17th century to the late 18th century, these technical features suggest that they were woven over a period not exceeding 40–50 years. There can be little doubt that all sashes of this type were woven at the same center.

The sari end-panels woven in this two-layer technique have cross-border patterns that are identical or nearly so to those that appear in some sashes. The flowering plant/tree patterns that appear in the main panel also belong to the same genre of design.[44] The cross-borders and the main panel are, in general, as finely designed and executed as those in the sashes. Other features such as warp counts, warp pattern step, and the direction of the twill binding on the face are identical or nearly so to those in the sashes, indicating that the same lineage of weavers wove both the sashes and the saris. There are, however, several important differences between the two types of products. Unlike the sashes, the side-borders of these saris are woven as a single layer patterned with supplementary wefts, the binding designed into the pattern. Outside the end-panel, patterning is executed mostly in metal. These sections of the two-layer saris represent, in a way, the antithesis of the refined Mughal style. The patterns are coarse and simplified as compared to those in the end-panel and reflect the considerably lower standard of design that characterizes most drawloom-woven textiles of the 19th and 20th centuries.

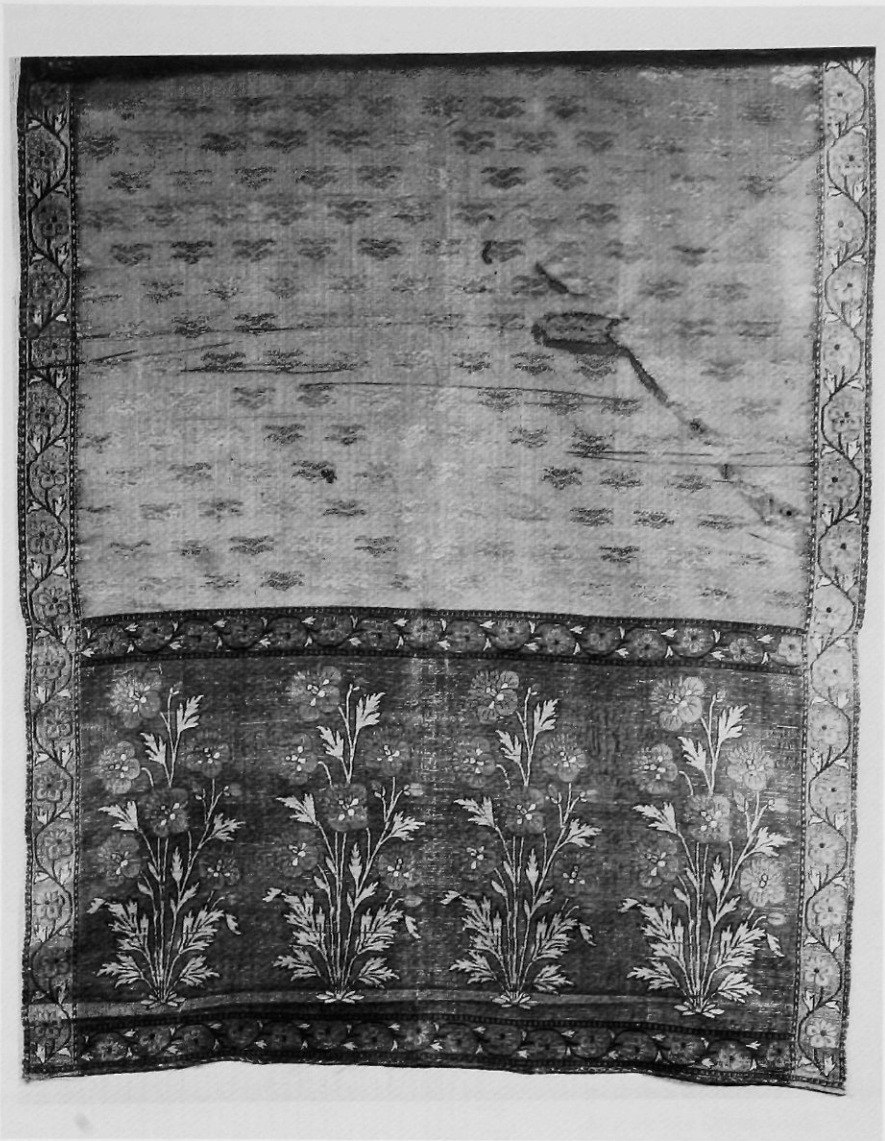
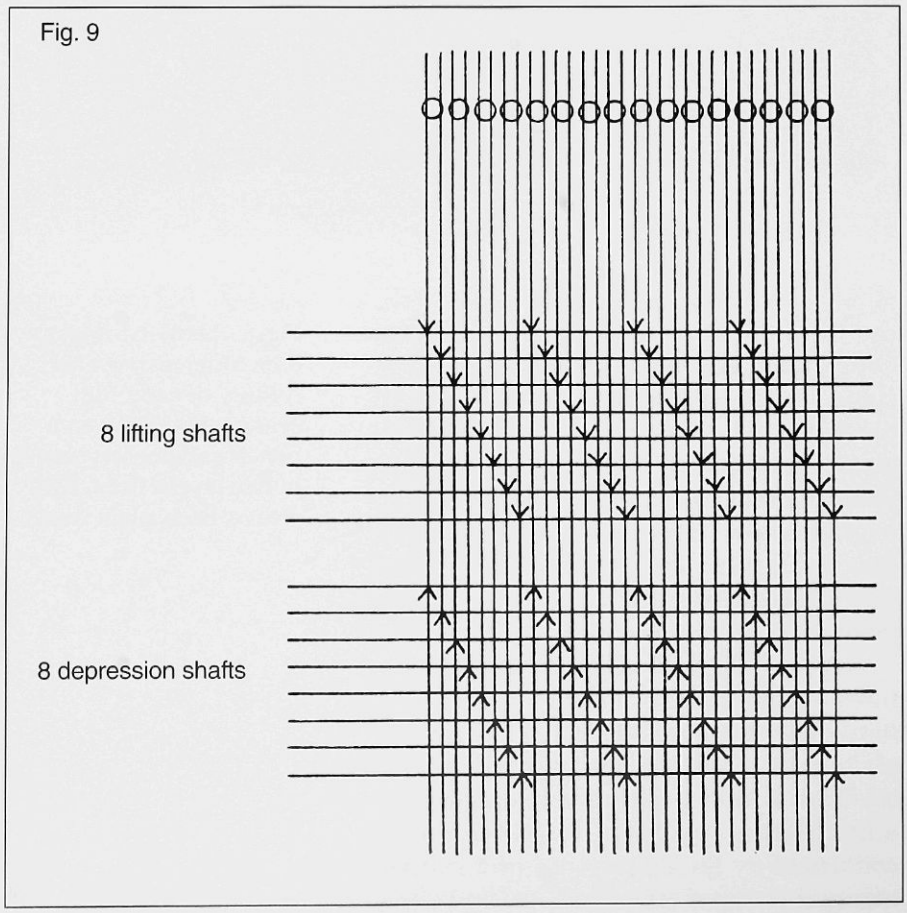


Fig. 8. Textile Museum 6.29, Mughal, late 17th century or early 18th century. Sash with end-panels and borders woven in two layers: front, twill weave; back, plain weave.

A second group of sari end-panels features a close variant of the two-layer technique.[45] In these saris, the front layer is a plain weave (as is the back layer) instead of a 1/3 twill. That these too were executed on a loom setup capable of twill binding is confirmed by the appearance of a supplementary-weft pattern outside the end-panel

in which the pattern wefts are bound to the plain-weave foundation in a 1/3 twill by foundation warps. Furthermore, selvedges, heading, and finish are treated in the same manner as in the twill-woven group. It is tempting, therefore, to argue that the two-layer, plain-woven saris were produced at the same center as the two-layer, twill-woven type. Several other features, however, suggest that the plain-woven saris may be products of a different center.[46] Their warp counts are significantly lower than those of the twill-woven type and the quality of patterning, even in the end-panels, much coarser.[47] The supplementary-weft patterning outside the end-panel is mostly executed in silk instead of metal as in the twill-woven type. The most unusual feature of the plain-woven saris, however, is the color palette, in particular the use of an inky blue dye that does not appear in the twill-woven group. It is also worth noting that there do not appear to be any sashes woven in this variant of the two-layer technique.

Fig. 9. Loom setup for two-layer sashes and saris.



Two groups of textiles closely related to the two-layer sashes and saris are executed differently in that their end-panels and borders are woven in a single layer. One group consists of sashes (fig. 10). Of two sashes[48] examined for this study, one has a twill-damask (3/1 and 1/3 twills) foundation patterned with discontinuous supplementary wefts bound on the face in a 1/3 twill by every other foundation warp. The same twill-damask structure is found in the field. The end-panel of the other sash has a 3/1 twill foundation patterned with discontinuous supplementary wefts bound in plain weave order on the face by every other foundation warp. The field is a twill damask. It is difficult to say whether these single-layer sashes were produced alongside the two-layer ones or whether they represent a deterioration in structure and technique over time. Both sashes could have been woven on the same loom setup as that used for the two-layer sashes. Although the end-panels are patterned with supplementary wefts (instead of substituting wefts as in the two-layer sashes), depression shafts were still needed for binding the pattern wefts in twill or plain weave order on the face.

A second feature that distinguishes the single-layer sashes from the two-layer sashes is the absence of a metal-woven background. Metal wefts are used only in the end-panel of one sash for small details of the flowering plant motif. This reinforces the suggestion that the plain-weave layer in the two-layer sashes was designed as a backing for the metal-woven twill layer and that the technique is not related to double cloth in which patterning is achieved by a complete interchange of the two layers.

In addition to the single-layer sashes, there exists a group of single-layer saris as well. One sari[49] examined for this study has a plain-weave foundation patterned with supplementary wefts that are bound on the face in a 1/3 twill by the first, second, fifth, and sixth warp in every eight foundation warps. This simple structure is easily executed on the loom setup employed for the more complex two-layer structure (fig. 9). The end-panel has a flowering cypress tree motif that is identical to one that appears in the end-panels of

several twill-woven, two-layer saris. Moreover, the warp count and treatment of selvedges, heading, and finish in the single-layer sari are also very similar to those in the twill-woven, two-layer saris. Both groups, no doubt, were woven at the same center.

Variations of this single-layer structure—a plain-weave foundation patterned with supplementary wefts bound on the face in a twill by individual foundation warp ends—are found in many other groups of textiles attributed to 19th century Gujarat. Often, these have outlined floral patterns executed in silk in several colors on a twill-bound metal background (as seen on a much finer scale in the sashes and saris woven earlier). Others are patterned almost entirely with metal-wrapped yarns. One important group consists of the *asavali* saris and veils of Ahmedabad. In addition, there are saris, veils, square covers, portraits, and religious textiles woven in this manner and variously attributed, in the absence of solid evidence, to centers such as Ahmedabad, Surat, or Jamnagar. In some saris and veils, the end-panel is a simple twill weave patterned with weft substitution. All these textiles required the use of depression shafts for binding the supplementary pattern wefts.

Very similar in style to the above are saris, veils, sashes, and covers in which a twill-like binding is inserted into the pattern itself, eliminating the need for depression shafts. The exact provenience of these textiles as well remains a matter of conjecture.

There appear to be far fewer examples of the second type of sash, the end-panels and side- and cross-borders of which are woven in a *taqueté* technique. The field, where intact, is a plain weave. In addition to the sashes, there are at least two square covers[50] and two rectangular canopies or saddle-covers[51] also executed in *taqueté*.

The loom setups (fig. 11) for the *taqueté* sashes are uncharacteristically elaborate. These were necessary in order to execute both the *taqueté* structure as well as the warp-faced plain weave found in the field, heading, and finish of the sashes. As shown by Sonday and Kajitani, the proportion of binder warps to inner warps of 1:3 or 1:4, as found in the side-borders, does not yield a true plain weave.

Fig. 10. Textile Museum 6.109, Mughal, 18th century. Sash with end-panels and borders woven as a single layer, twill damask foundation patterned with discontinuous supplementary wefts.

Unlike the two-layer technique discussed above, the *taqueté* technique appears often in Iranian textiles from a very early period. Existing analyses suggest that it was the technique of choice for Iranian sashes.[52] Although technical information on Iranian *taqueté*-woven sashes is lacking, preliminary analysis suggests that the entering of the inner warps into the structure shafts is quite different from that in the Indian examples. Iranian sashes appear to be woven with numerous continuous complementary wefts in each shed, resulting in a relatively stiff fabric. The Indian *taqueté* sashes, by contrast, have no more than three continuous complementary wefts in each shed with extra colors introduced by discontinuous complementary wefts. Once again, whether this Indian technique has an Iranian origin remains an open question.

The earliest Indian *taqueté*-woven pieces appear to be two "military" sashes from the treasury of King Gustavus Adolphus of Sweden (d. 1632) dated to the

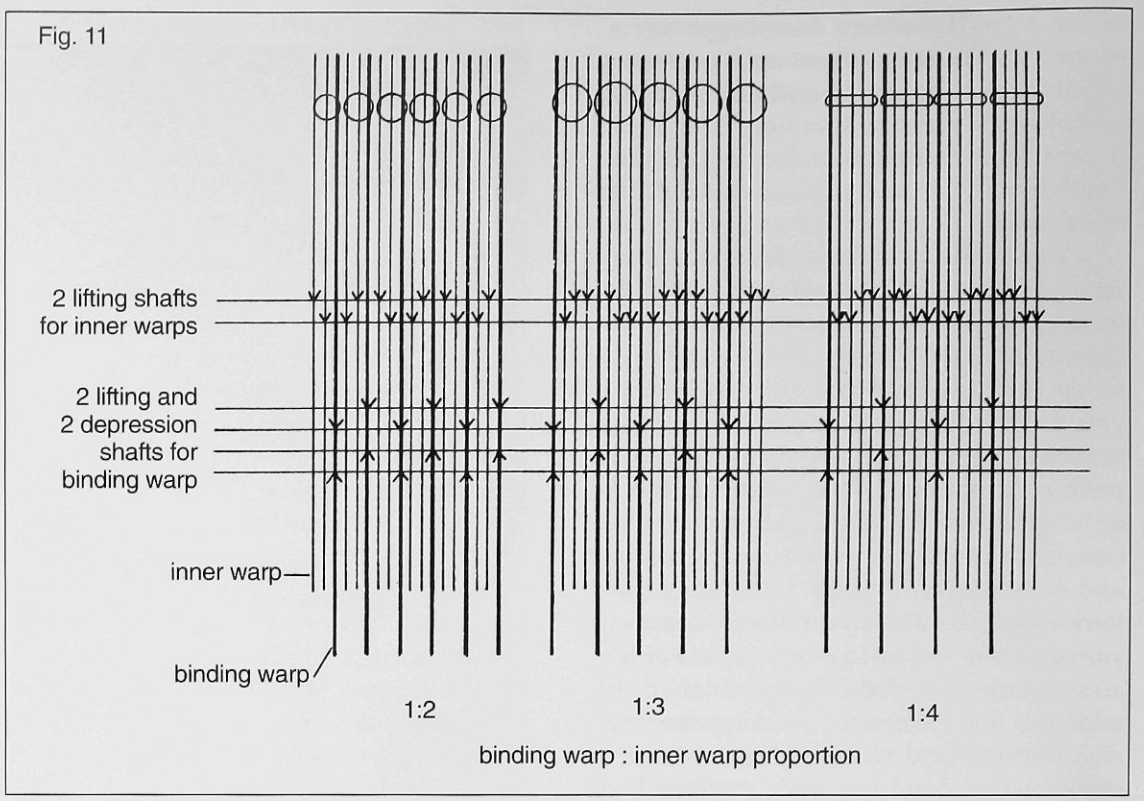


Fig. 11. Loom setup for *taqueté* sashes.

early 17th century. Both are simple in design, coarse in weave, and, according to Irwin, rather carelessly executed.[53] The proportion of binder warps to inner warps is 1:2. These do not appear to be products of an imperial workshop woven under the direction of foreign master weavers, which may suggest that this technique was being used in India independently of its possible importation and use in the Mughal workshops.[54]

The later *taqueté*-woven sashes also have a proportion of binder warps to inner warps of 1:2 (with 1:3 or 1:4 in the side borders) but are far more elaborately patterned and finely executed (fig. 12). These sashes probably pre-date two covers (or saddle-cloths) that 19th century writers have identified as products of Ahmedabad.[55] The covers have a proportion of binder warps to inner warps of 1:4 and a noticeably coarser warp pattern step. In both the sashes and the covers, the metal wefts, instead of floating freely at the back as in the case of the two-layer sashes, are bound everywhere into the complementary-weft structure. The use of discontinuous complementary wefts that float freely at the back in the sashes, however, confirms the use of depression shafts in their case.

Although technical analyses are unavailable, two rectangular canopies mentioned above appear to be closely related to the covers. They have the same pattern in the field as found in the covers, and very similar borders and corner motifs.

The design elements in the covers and canopies echo late Mughal tradition. The appearance of a stock parrot-creeper pattern (*popat vela*) in the borders of one cover and one canopy[56] suggests a stylistic link to the twill-woven, two-layer saris and the *asavali* saris of Ahmedabad that sometimes feature this pattern in their side- and/or cross-borders.

In general, the technique and floral design of the covers and canopies support the attribution of the *taqueté* sashes to 18th century Ahmedabad. The increase in the number of inner warps per binding warp, together with a coarsening of the warp pattern step, may indicate a general deterioration in the quality of drawloom-woven textiles from Ahmedabad by the early 19th century. Finally, it is important to note that neither the two-layer technique nor the *taqueté* technique appear in any of

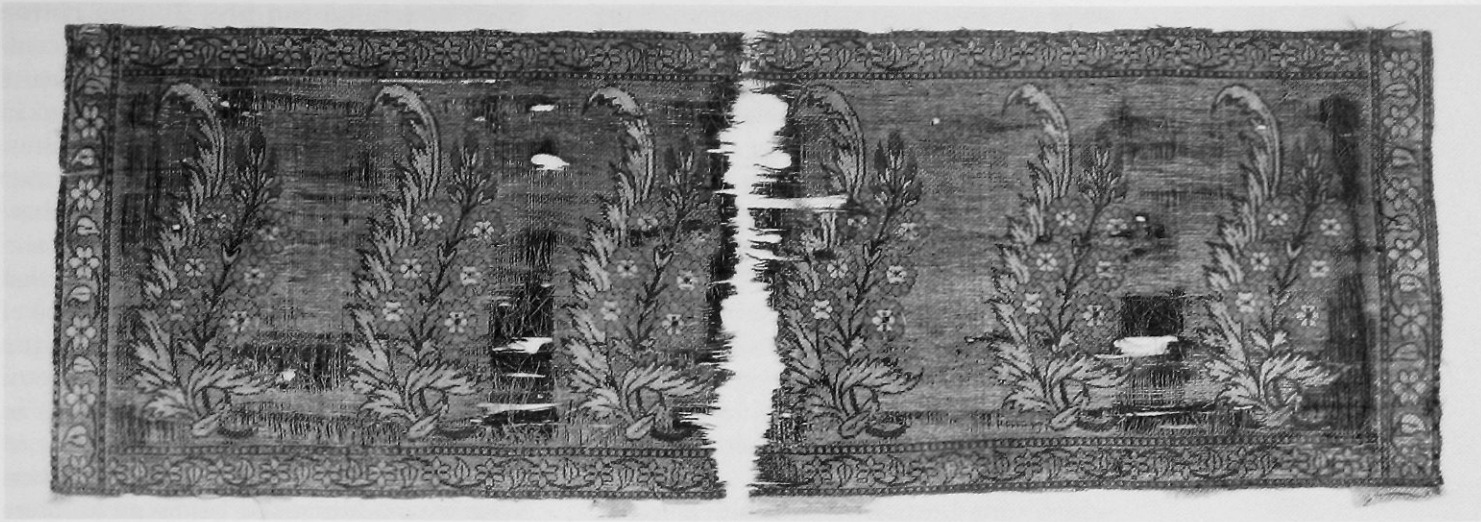


Fig. 12. Textile Museum 6.31, Mughal, 18th century. Sash end-panel woven in a *taqueté* technique.

Watson's textile specimens from mid-19th century India. In all probability, the use of these complex techniques disappeared sometime in the first half of the 19th century.

Interchange of Naqsha: In the group of two-layer sashes and saris, patterns for the end-panels, the side- and cross-borders, and in some cases, for the field as well, appear in different combinations in different textiles. This suggests that *naqsha* for the different patterns were stored and freely mixed and matched when necessary and that the double-woven sashes and saris are all products of the same workshop.

In the case of the *taqueté* covers and canopies as well, identical patterns for the field, borders, and corner motifs appear in the different textiles, suggesting that these too are products of one workshop.

Number of Crosscords and Lashes: Calculated on the basis of warp counts, warp pattern step, and width of the pattern, the maximum number of crosscords needed for any of the sashes was probably no more than 400. Since warp counts or the warp pattern step do not appear to vary significantly, this number was needed for a sash that has only four repeats of the flowering-plant pattern in the end-panels. Sashes with six repeats in the end-panels appear to be by far the most numerous and a few have more than six repeats. These, then, required fewer crosscords.

In this context, it is worth pointing out that many published Iranian sashes have five, and sometimes seven, repeats of the floral pattern in the end-panels, although four, six, and eight repeats occur as well. Among Indian sashes, on the other hand, uneven numbers of repeats appear only in tapestry-woven sashes attributed to Chanderi or centers in western India.

In general, the increase in the number of repeats in the end-panel of the Indian sashes is accompanied by a decrease in the height of the panel and the flowering plant motif, indicating that fewer lashes were needed for the pattern. Thus, with fewer crosscords/drawcords and fewer lashes, smaller *naqsha* were needed for such sashes, indicating a decline in technical quality over time.

Patterning of the Side- and Cross-Borders: In the 60-odd sashes and saris of the two-layer and *taqueté* types examined for this study and published elsewhere, the floral creeper pattern of the side-borders runs independently of the pattern in the cross-borders. There is no attempt to "miter" the creeper pattern where the side- and cross-borders meet, the creeper does not run endlessly along all four sides of the end-panel. In weaving the Indian sashes, therefore, the *naqsha* for the side-borders was calculated, prepared, and probably operated independently of the *naqsha* for the end-panels and cross-borders. This independent side-border remains a characteristic of drawloom-woven saris and other unstitched apparel to this day.

Iranian sashes (and many Polish ones as well), by contrast, frequently feature mitered side- and cross-borders, indicating

a more sophisticated calculation underlying the design. For proper mitering, the sizes of the pattern repeats in the side-borders, cross-borders, and end-panels must all be perfectly coordinated. Further calculations are needed to ensure that this happens at both ends of the sash. Once again, it seems odd that imperial quality textiles presumably woven under the direction of Iranian master weavers should not feature the most advanced skills of the imported craftsmen. This is all the more surprising in view of the probability that some of the Indian sashes under discussion were woven as late as the second half of the 18th century, by which time Iranian sashes with mitered borders were well known in India.[57]

Perfectly mitered borders do appear in several Indian textiles dated to the 17th century, including patterned velvets as well as two floorspreads woven in the *lampas* technique.[58] There is little doubt that, as in the case of these velvets and the *lampas* floorspreads, the sashes were woven for court use. Therefore, why the skills used in mitering the border designs of the velvets and *lampas* textiles were not applied to the sashes (or textiles of a later date) is a mystery. One possible explanation may be that the velvet and *lampas* techniques were being used under Iranian direction in the Mughal workshops, whereas the two-layer and *taqueté* techniques were not. Were the latter techniques being used under the direction of master weavers imported from Central Asia or Turkey or perhaps their Indian descendants? More generally, were complex techniques the sole preserve of the imperial drawloom workshops of Ahmedabad or were they also being used in other important centers in Gujarat such as Surat? Answers to these questions require a better understanding of the organization of craftsmen, techniques, and products in the imperial workshops which seems more complex than has been generally assumed. It is not clear how the nature of these workshops changed as Mughal power waned in the 18th century, or how this may have affected the use of specific weave structures and patterning techniques in different centers in Gujarat.

Use of Cotton Wefts and Cotton Cord Selvedges: All the two-layer and *taqueté* sashes examined for this study had doubled or tripled (no ply) Z-spun cotton wefts in the field as well as selvedges composed of a single cotton cord, a feature noted as well by Sonday and Kajitani in their discussion of the Mughal sashes. These features are also found in the two early Indian sashes in Sweden. Furthermore, cotton wefts appear in the two single-layer sashes, but only one has a cotton cord selvedge, the other having a stripe of doubled silk warps. The use of cotton wefts appears to be a salient feature of 18th century "silk" textiles woven in Gujarat, pointing both to the scarcity of silk and a strong local tradition of cotton weaving. As discussed below, in all these textiles, warp-faced foundation weaves are used to hide the cotton wefts.

In the case of the two-layer and single-layer saris as well as the *asavali* saris, cotton wefts appear only in the heading and finish. They do not appear at all in the *taqueté* covers and canopies. Moreover, all these textiles have selvedges composed of a silk cord. This suggests that the use of cotton wefts and cotton cord selvedges disappeared from these types of products by the early 19th century.

Sash Widths: Widths vary among and within the different groups of sashes. The two-layer sashes examined for this study and published elsewhere, for example, vary in width from about 48 cm to 57 cm, the median width[59] being 50–51 cm. The two single-layer sashes, one 48 cm and the other 50 cm wide, fall within this range.

The *taqueté* sashes, on the other hand, are narrower, with widths varying from about 42 cm to 47 cm, the median width being about 44 cm. The two Indian sashes in Sweden, however, are 48–50 cm wide and fall just outside this range. By contrast, most of the Iranian *taqueté*-woven sashes appear to be considerably wider—usually about 60 cm or more.[60]

Stylistic Aspects: As mentioned above, extant Mughal sashes are thought to date from the second half of the 17th century to the late 18th century. Dating them more securely remains problematic. Kahlenberg has attempted to develop a chronology drawing on parallels in 17th and 18th century Indian miniature painting,[61] basing her judgment on the degree of stylization of the flowering plant motif in the end-

panels and the end-panel height. While the classic Mughal flowering plant motif from the second quarter of the 17th century is relatively easy to recognize, its subsequent development in Mughal architecture, painting, printed/painted textiles, woven silk textiles, embroidered textiles, Kashmir shawls, etc., is not well established. Researchers have identified different features of the plant motif that may suggest a logical stylistic development over time. Relying on characteristics such as the degree of realism, botanical accuracy, the number and arrangement of blossoms on the plant, secondary features such as roots, mounds, and vases, the number of plant species, and the spacing of repeats, however, seems too mechanical and oversimplified an approach. Not surprisingly, there are wide variations in the dating of Mughal textiles sharing identical or similar stylistic characteristics.

Furthermore, little attention has been directed to the fact that the stylistic characteristics of a motif may be affected by the medium and technique in which it is executed. For example, a large tent-panel (*qanat*) with a flowering plant under an arch, woven on a drawloom with a pattern harness set up for one point repeat (to economize on crosscords, yet double the pattern width) will necessarily have a vertical axis of symmetry. It may thus visually appear to be less naturalistic, leading to a later attribution than one might assign the same design freely embroidered or painted on cloth. Finally, it is important to note that by the second quarter of the 17th century, another type of motif begins appearing frequently on the apparel depicted in paintings.[62] This is a small, stylized floral spray or shrub arranged in a typical offset repeat, further complicating the problem of identifying a distinct stylistic development in the more prominent flowering plant motif.

Silk-Brocaded Simple Satins[63]

A second group of textiles, generally attributed in museum collections to 18th century Surat, have a 4/1 satin-weave foundation (counter of 2; C.I.E.T.A. term: *décochement*) patterned with discontinuous supplementary wefts bound irregularly by groups of two or three foundation warps on the face and float freely at the back. With the binding points designed into the pattern, no depression shafts were needed. Their main characteristics include: (1) the use of silk warps with paired, Z-spun cotton wefts that are hidden by the warp-faced satin weave; (2) typical asymmetric floral patterns in offset (but not reversed) rows, sometimes alternating color; (3) small pattern repeats requiring relatively few crosscords (no more than 150 for the items examined) and lashes; (4) warp pattern step of 2 or 3; and (5) discontinuous supplementary wefts of silk. None of the examined items had their selvedges intact. A few Indian examples suggest that there may be subgroups within this broad category. One type, for example, has an irregular 3/1 twill-weave foundation with silk warps and cotton wefts. Unlike the satin-woven textiles, metal wefts are used to execute parts of the floral pattern.[64]

Iranian brocaded satins dated to the 17th and 18th centuries, by contrast, appear to have silk warps and wefts, although a few later examples do show the use of cotton wefts. Straight pattern repeats are typically larger and reversed in direction in alternate rows (although point repeats occur quite often) and metal wefts are used liberally together with silk wefts for patterning. Unlike the Indian examples, the discontinuous supplementary wefts in most cases are either: (1) bound regularly on the face in twill order by every second or third foundation warp (and float freely on the back), necessitating the use of depression shafts; or (2) float freely on both face and back.

Watson's collection of 19th century specimens includes several brocaded satins. Their technical and stylistic features are very similar to those of the 18th century examples. These are identified as *mashru* of Hyderabad, although examples of the related *himru* suggest that similar textiles were also being woven in other centers such as Aurangabad. The sparsely set satin-weave foundations, harsher coloring, coarse patterning, and the floral patterns reversed in alternate rows (in some cases), however, easily distinguish these later examples from the fine quality brocaded satins attributed to 18th century Gujarat.

Silk-Brocaded Plain Weaves

A third group of textiles, also attributed to 18th century Surat, are stylistically very similar to the satin weaves. They have a plain weave foundation patterned with discontinuous supplementary wefts that are bound irregularly by groups of two foundation warps on the face and float freely on the back. Binding points are designed into the pattern, indicating that no depression shafts were needed. Their main characteristics include: (1) the use of silk warps with Z-spun cotton wefts that are partly hidden by the mostly warp-faced plain weave; (2) asymmetric floral patterns in offset (but not reversed) rows, sometimes alternating color; (3) small pattern repeats requiring relatively few crosscords (no more than 150 for the textiles examined) and lashes; (4) warp pattern step of 2; (5) discontinuous supplementary wefts of silk.

All the examined items had prominent reed marks[65] after every 4 warps. Irregularities in the foundation weave indicate errors in threading the warp through the foundation shafts. In preparing the loom for weaving these textiles, groups of two warps were entered into the leashes (for a warp pattern step of 2) but groups of four were entered into each dent of the reed. This differs from the present-day practice in Varanasi, where, as noted earlier, weavers insist that the same number of warps must be entered into each leash and each reed dent for obtaining clear pattern sheds.

There may be subgroups within this category as well. One type has some parts of the pattern executed with a metal weft. Selvedges were missing from all the examined pieces but one, which had a stripe of doubled foundation warps in a continuation of the plain weave.All the Iranian brocaded plain weaves examined for this study had silk warps and silk wefts, as in the case of the satins. The use of smooth silk wefts evens out the spacing of the warps and, unlike the Indian examples, reed marks are virtually absent. The offset and reversed repeats are invariably larger and metal wefts are used liberally together with the silk wefts.

As in the case of the brocaded satins, Iranian plain weaves appear to have a warp pattern step and warp count very similar to those in the Indian textiles. The generally larger size of pattern repeats in the Iranian examples therefore indicates that larger *naqsha* were the norm in Iran.

Metal-Brocaded Simple Satins

A fourth group of textiles, usually attributed to 19th century Varanasi, are characterized by relatively large pattern repeats brocaded almost entirely with metal wefts. Silk pattern wefts are used in some cases, but only to accent small details. These textiles have a 4/1 satin-weave (counter of 2) foundation patterned with discontinuous supplementary wefts that are irregularly bound either by groups of three or four foundation warps or floated freely on the face, and floated freely on the back, binding points being designed into the pattern, so depression shafts were not needed. Other important characteristics include: (1) the use of silk warps with silk wefts (unlike the textiles attributed to Gujarat); (2) warp pattern step of 3 or 4, scaling up the size of the repeat yet economizing on the number of crosscords (fewer than 250 were needed for any of the textiles examined); (3) repeats in an offset (but not reversed) arrangement. Selvedges were missing from all the examined items but one, which had a stripe of doubled foundation warps in a continuation of the satin weave.

Riefstahl illustrates a number of such textiles from an Indian merchant's sample book from the first half of the 19th century containing Varanasi "brocades."[66] Similar textiles are also illustrated by Mehta[67] and Singh[68], each indicating that these are products of 19th century Varanasi. Watson's specimens, on the other hand, include one example from Ahmedabad[69] with technical and stylistic features that are very similar to Varanasi brocaded satins. It thus appears that such textiles were woven in both Varanasi and Ahmedabad. That related textiles were woven at other centers is confirmed by a specimen from Aurangabad included in Watson's collection.[70] Unlike the products from Varanasi and Ahmedabad, the example from Aurangabad has cotton wefts and a floral pattern that is reversed in alternate rows.

Metal-Faced Complex Satins

The fifth group of textiles is characterized by a surface almost entirely faced with metal wefts, with parts of the pattern executed in silk. Heavy and stiff in construction, these have been generically referred to as the true *kimkhwab* or *kincob* suitable only for rigidly styled apparel, furnishings, trappings, etc. Textiles with the same trade name appear to have been woven in centers in Central Asia and Iran since at least as far back as the 14th century. Their structure, technique, materials, and stylistic features, however, remain a matter of conjecture.[71]

Some of the Indian textiles in this group have a 4/1 satin-weave (counter of 2) foundation with multiple (usually two and sometimes three) wefts. All, or all but one, of the satin wefts are used for patterning and are irregularly bound on the face by groups of two or three foundation warps. Additional patterning is achieved by continuous and discontinuous supplementary wefts, either bound on the face by groups of two or three foundation warps or floated freely. The binding points are designed into the pattern and no depression shafts were needed. As noted above, variations of this structure have been used for weaving *tanchoi* as well as some types of *gyasar* fabric. Other textiles in the group have a simple 4/1 satin-weave foundation patterned only with continuous and discontinuous supplementary wefts, otherwise similar to the type described above.

Important characteristics of this group include: (1) the use of silk warps with silk wefts; (2) a warp pattern step of 2 or 3; (3) relatively small (sometimes point) repeats (fewer than 200 crosscords were needed to pattern any of the examined items). In some cases, selvedges consisted of a stripe of doubled silk warps of a different color in a continuation of the satin weave. In all cases, the metal wefts are turned before reaching the selvedge. Between the selvedge and the patterned field, two narrow, vertical stripes of the satin weave alternate with two prominent metal-woven stripes. Riefstahl illustrates numerous examples of such fabrics from the 19th century sample book of Varanasi products.[72] Many show the same distinctive selvedge treatment noted above. Nabholz-Kartaschoff illustrates two such textiles with this particular selvedge treatment. One is attributed to late 19th century Varanasi,[73] the other, with a more refined, Iranian-style design, to late-18th century Aurangabad.[74] Watson's collection includes specimens of metal-faced textiles from both Varanasi and Ahmedabad that are identical both technically and stylistically.[75] Moreover, similar textiles appear to have been woven in Surat as well in the 19th century.[76]

Advanced Uses of the Pattern Harness in 19th Century Textiles

A range of 19th century textiles show certain design treatments that require an advanced manipulation of the pattern harness components. The unusual flexibility of the pattern harness of the Indian drawloom has been documented above. The paragraphs that follow review two advanced applications of this feature. It should be noted that these are effective only in brocaded textiles, *i.e.*, those in which patterning is achieved by introducing discontinuous (usually supplementary) wefts.

The first application may be unique to Indian drawloom-woven textiles. It is based on the ability to reverse the direction of repeats as well as to use two or more pattern repeat systems with different repeat sizes in the same textile. These features find their most prominent use in 19th century saris and shaped fabrics woven for stitched garments. Although a detailed description of the weaving process in these cases is beyond the scope of this paper, the principles underlying a typical case are reviewed below for illustration.

Numerous 19th century saris are patterned with two large corner motifs (*konia*) placed in the corner angles formed by the inner edges of the end-panel and two side-borders (fig. 13a), and, in some cases, with a large central medallion (*chakra* or *chand*) as well. The use of a central medallion and quarter medallions in Indian textiles is probably derived from the tradition of Iranian carpets and bookbindings dating back to the 16th century. Among woven textiles, central medallions with true "quarter" medallions appear in Kashmir shawls and saris attributed to centers such

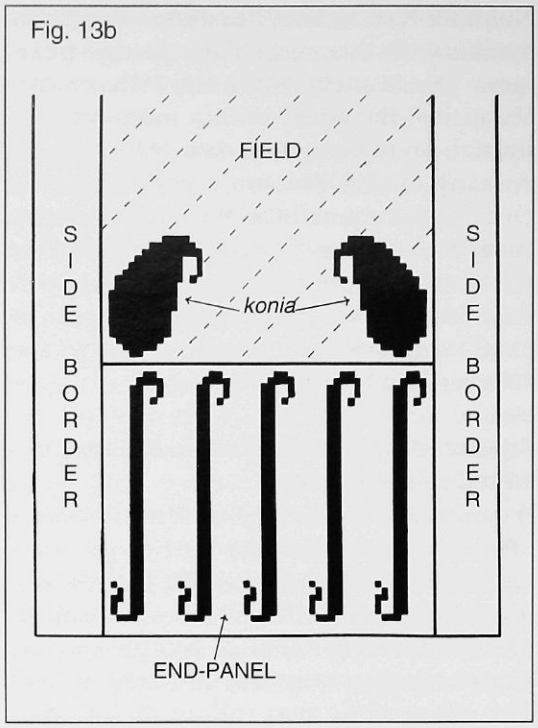
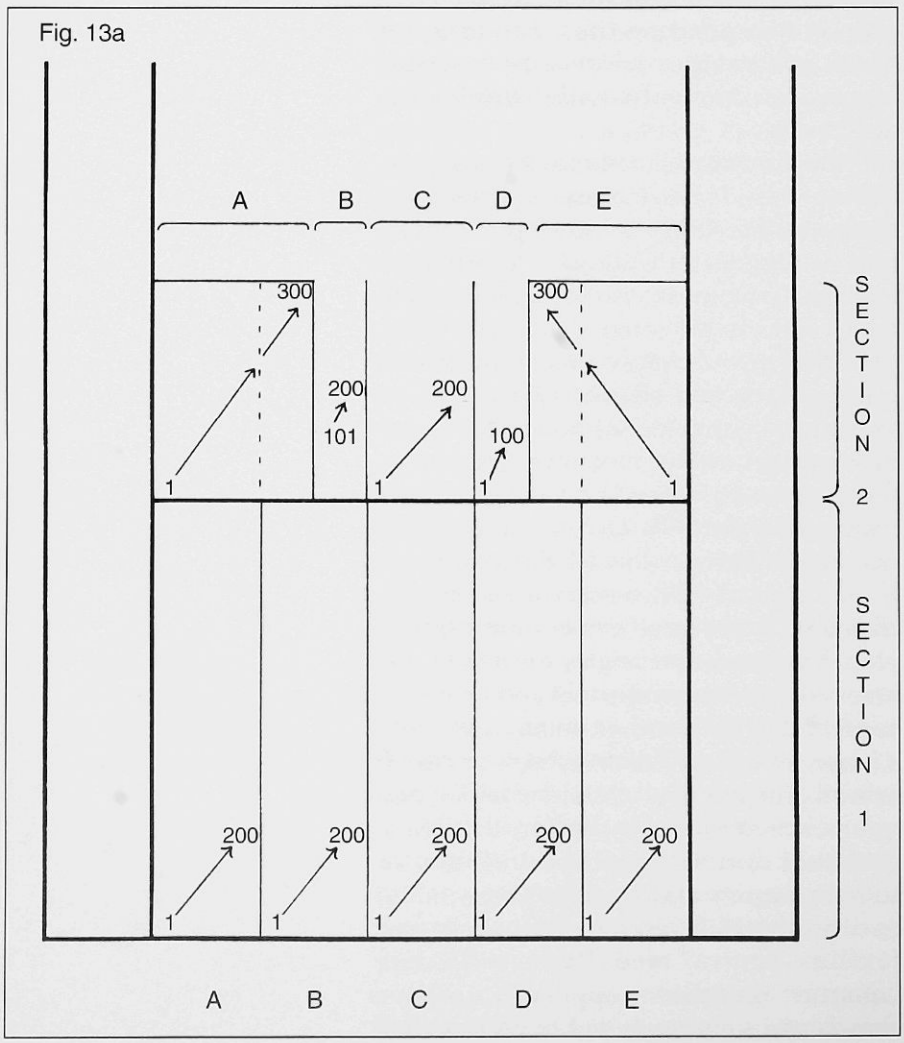


Fig. 13a, b. Changing the size and direction for pattern repeats.



as Chanderi and Paithan, woven in tapestry techniques. In drawloom-woven saris, on the other hand, the *chakra* may be combined with rectangular *konia* as in some *asavali* saris from Ahmedabad or with ornamental paisley *konia* in saris from Varanasi and other centers. In many cases, *konia* appear without the *chakra*. While free-patterning techniques such as carpet knotting or tapestry weaving permit using the central-and-quarter-medallion type of design scheme with ease, using the pattern harness of a drawloom for this purpose presents quite a challenge.

As shown in figure 13b, the size of the *konia* repeat is normally larger than the size of the basic pattern repeat used in the end-panel and field of the sari. Furthermore, the two *konia* usually face each other —they are arranged in a point repeat with respect to one another. The underlying pattern repeat of the sari, on the other hand, is normally in straight arrangement. The *chakra* differs from the sari's basic pattern repeat system in exactly the same respects.

The pattern harness of the drawloom is set up with as many crosscords as are required for the largest pattern used in the sari (normally, the *konia*) 300 crosscords according to figure 13b. However, to weave Section 1, the leashes are tied to only the first 200 cords for the five straight repeats A, B, C, D, and E of the end panel. After weaving Section 1, the remaining 100 crosscords are needed as well in order to weave the *konia* in Section 2. Therefore, the first 100 leashes of Repeat B are untied from crosscords 1–100. In their place, leashes are added to crosscords 201–300, as shown, increasing the size of Repeat A from 200 to 300. Similarly, the last 100 leashes of Repeat D are untied from crosscords 101–200. In their place, leashes are added to crosscords 201–300 in the reverse order. Furthermore, all 200 leashes from Repeat E are untied and retied to the crosscords in the reverse direction. This increases the size of Repeat E from 200 to 300 while reversing its direction. Thus, Repeats A and E are now larger than the others and also in a point arrangement with respect to one another. While these changes in the pattern harness may seem relatively straightforward, the ingenuity of

the Indian weavers lies in the fact that these changes are not made all at once. According to the weavers, the untying and retying of leashes is done in a number of stages separated from each other by weaving a few weft rows. This permits brocading the straight-repeating pattern in the field right up to the edges of the *konia* pattern, *i.e.*, within the areas occupied by Repeats A and E. If all changes were made prior to weaving, this would not be possible in the case of the field pattern surrounding the *konia* in Repeat E, for the direction of the leashes has been reversed (thus, reversing the direction of the field pattern as well in that repeat).

A second application concerns the flexibility of any drawloom harness compared to that of a jacquard in allowing a number of different patterns to be brocaded side-by-side in the same textile. In the Indian case, each pattern would require its own *naqsha* tied to the crosscords. The large numbers of *naqsha* that are sometimes used simultaneously suggests that the horizontal configuration of the crosscords allow tying in and operating a larger number of patterns with greater ease than, say, the vertical "simple" cords of the European drawloom.[77]

The most extreme case of several *naqsha* being used together is found in 19th century *baluchar* saris of Murshidabad in Bengal to the east. One survey conducted at the end of the 19th century records the use of as many as 14 *naqsha* for weaving one sari, most being required for the elaborate end-panels.[78] The end-panel of one *baluchar* sari examined for this study,[79] for example, required some seven *naqsha* for patterning. In exceptional cases, the use of numerous *naqsha* may be combined with a reversal of direction of selected repeats over short stretches and/or with a change in their size. In one case, a calculation showed that duplicating such effects with a comberboard-lingo type harness would require more than 2000 hooks or drawcords, depending on whether a jacquard or some other type of drawloom was used for weaving. That no more than 400 crosscords were required to weave the sari illustrates the great efficiency of the Indian pattern harness in these special cases.

Observations on the Use of the Indian Drawloom

Based on the preceding discussion, several conclusions can be drawn about the use of the Indian drawloom in the past:

Regarding the use of complex techniques in the textiles discussed above, the absence of *samit*, double cloth with complete interchange of layers, or satin-based damask seem particularly striking in view of the use of related techniques such as *taqueté*, *lampas* (not discussed in this paper), and the type of double weave and twill-based damask found in one group of sashes and saris. In general, this points to the lack of a history of indigenous development of these techniques in India and to their transplantation from foreign centers. It may also reflect the innate conservatism of the Indian weavers compared, for example, to the inventiveness of their Iranian counterparts. Apart from the complex techniques, several simpler weave structures commonly found in 17th and 18th century Iranian textiles do not appear in Indian textiles from that period. None of the brocaded plain or satin weaves attributed to 18th century India, for example, show the supplementary pattern wefts bound in twill order by single foundation warp ends. A simple twill-weave foundation patterned with weft substitution, found in a large group of Iranian metal-ground textiles, does not appear either. Inexplicably, these weave structures do appear in several groups of 19th century textiles attributed to Gujarat. If these were in use earlier, either the material evidence has disappeared or has yet to be securely identified.

Overall, technical and design characteristics of the textiles discussed in this paper suggest that the Indian drawloom weaving tradition is less allied to the Iranian one than is generally believed. Whether it owes more to the Central Asian or Turkish weaving traditions, however, is a question that will require substantial additional research.

The use of depression shafts (for binding pattern wefts) is evident in the cases of the two-layer sashes and saris, the single-layer sashes and saris, the *taqueté*-woven covers and canopies, as well as several groups of 19th century textiles, all attribut-

able to centers in Gujarat. The original structure and technique of the *asavali* saris are still in use in a few villages in Gujarat, notably Ridrol near Ahmedabad. The use of depression shafts, therefore, has been a consistent feature of silkweaving in Gujarat up to the present day.

Unlike the products mentioned above, neither the silk-brocaded plain weaves and satins attributed to 18th century Gujarat nor the metal-brocaded simple satins and metal-faced complex satins attributed to 19th century Varanasi, Ahmedabad, Surat, Aurangabad, and other centers required the use of depression shafts for binding pattern wefts. Other historical textiles attributed to Varanasi do not show the use of depression shafts either. Furthermore, among Watson's swatches collected from centers all over India in the mid-19th century, there is not one example of a drawloomed textile requiring depression shafts. It appears, therefore, that the use of depression shafts in India, either for complex techniques or for binding pattern wefts in simple techniques, has been confined to a few groups of textiles woven in Gujarat.

No more than 300–400 crosscords were needed to pattern any of the textiles discussed in this paper, the highest numbers being used for the better quality sashes. Frequently fewer than 200 were used for patterning simpler brocaded fabrics. In contemporary usage, 200–250 crosscords are standard for weaving most saris. An additional 100–200 may be used for side-borders.

Similar types of Iranian textiles from this period invariably show larger repeats and a generally higher range in the numbers of crosscords needed for patterning. Although such information on Iranian sashes is not available, the numbers of crosscords needed for the distinctive metal-ground textiles dated to the 17th and 18th centuries are often in the 350–650 range.[80] Similarly, high quality *lampas*-woven textiles show the use of some 400–600 crosscords,[81] while the patterned velvets top all other types of textiles in requiring anywhere from 1500 to 3000 crosscords.[82] Moreover, the size of Iranian *naqsha* can be further gauged from the fact that some 3000–5000 lashes were required for such *lampas* textiles, with the velvets requiring 1000–3000 lashes.[83] Comparative information is not yet available for high quality Indian *lampas* textiles and velvets.

In the case of drawloom silk-weaving in 17th and 18th century Italy, France, and England, published analyses show brocaded and unbrocaded *lampas* and satin-based damask as well as brocaded satin and plain weaves to be the most frequently encountered techniques.[84] Unlike the fairly standardized use of these techniques in Iran and India, numerous variations and technical refinements were developed within each category by European silk weavers. These sophisticated weave and design treatments had reached their zenith by the late 18th century, particularly in France.[85] By contrast, complementary-weft techniques such as *taqueté* and *samit*, developed into a number of variations in Iran, do not seem to have been used in Europe at all. Patterned double and triple cloth techniques, also handled with great technical sophistication by Iranian weavers, do not seem to have been in common use either.

European design conventions generally called for larger repeat sizes than were typical in Indian textiles. Archival records from the 18th century show the use of 400–500 drawcords to be the norm for patterned silks in both France[86] and England.[87] This number was, no doubt, exceeded in the case of the numerous special commissions woven for European nobility. The advent of the jacquard in the early 19th century facilitated the weaving of patterns requiring very large numbers of cards (which replaced the lashes of the drawloom). Exceptional examples include a brocaded satin that required 80,000 cards, paisley shawls requiring over 100,000 cards, and an extraordinary prayer-book woven in the *lampas* technique requiring some 500,000 cards.[88]

In conclusion, technical accomplishments in Indian drawloom weaving remained somewhat limited compared to those attained in Iran or Europe in the 17th and 18th centuries. But Indian weavers appear to have gone much further than their international counterparts in exploiting the technical possibilities of drawloom weaving by applying the flexibility of their pattern harness to unusual ends.

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About the author

Rahul Jain, an economist by training, is a handweaver with a special interest in the history and practice of drawloom weaving. Formerly at the World Bank in Washington, D.C., he now runs a silk-weaving workshop in New Delhi to recreate the technique, material, and style of certain complex fabrics woven for the courts of Mughal India and Safavid Iran in the 17th and 18th centuries.

Notes

1. Emery 1980.

2. For a description of these weaves, see Burnham 1980.

3. For example, an important group of Iranian metal-ground textiles appear to be derived from the *samit* technique (see, for example, cat. nos. 16, 19, 20, 21, and 54 in Bier 1987). In the classic *samit* structure, the weft-float face of the twill binding is on the front, the warp-float face at the back, and the inner warps are critical for pattern control. In this group of metal-ground textiles, however, the treadling of the binding warp system is such that the resultant structure has the weft-float face of the twill binding on both sides, resulting in a twill weave "faced" with a second twill weave, with inner warps. In this structure, the inner warps are no longer needed for pattern control, although they still serve to lengthen the floats of the pattern wefts. Moreover, in some cases, the inner warps are used very creatively to bind discontinous pattern wefts in a separable double weave on the face of the fabric (I am indebted to Milton Sonday for pointing out these unusual technical features to me). Calling this structure a *samit* would be, quite clearly, both misleading and unmindful of the ingenuity of the Iranian weavers. At best, then, such terms only establish a type of structure, but do not describe the precise interlacing of the warps and wefts in a given textile.

4. The *lampas* textiles are the subject of a study being conducted under the direction of the *Association Pour l'Étude et Documentation des Textiles d'Asie* (A.E.D.T.A.), Paris, and the Calico Museum, Ahmedabad.

5. See, for example, Hooper 1953; Becker 1987.

6. See, for example, Mohanty 1984; Becker 1987; DuBois 1985; Jayakar 1967.

7. Serjeant 1972, p. 113.

8. Riazuddin 1988, pp. 139–143.

9. Crill 1992.

10. Slomann 1953, p. 87.

11. The depiction of luxurious textiles with typical Safavid figural patterns or the Turkish "chintamani" motif in 17th century Mughal paintings, as well as written evidence of textile imports from Iran and other regions, attests to the Mughal craze for fine textiles.

12. Wulff 1966, pp. 205–208; Becker 1987, pp. 257–261.

13. All four components were traditionally made of cotton cord, but now the crosscords and lashes are often made of nylon cord.

14. Becker 1987, p. 257.

15. Hill 1990.

16. For a discussion of pattern repeat systems, see Sonday 1987.

17. Instances of drawloom weaving in which single warp ends were entered into the leashes of the pattern harness are uncommon. Invididual warp end control obviates the need for a separate set of shafts for weaving the foundation fabric or for binding purposes and this principle is normally used in modern jacquard weaving. In the historical examples, however, it is most likely that shafts were used to weave the foundation fabric independently of the pattern harness even when the leashes carried single warp ends. Also, in connection with drawloom weaving conventions in Europe, both Hooper and Becker point out that when several warp ends are entered together into one leash, they are apt to twist about each other (necessitating the use of mails with multiple eyes). This is not borne out by the experience with the Indian pattern harness. One possible explanation for this may be the use of higher ply and twist in the European warp yarns.

18. This term is preferred over "loom assistant" or "helper" because it denotes a specific task. Furthermore, it is not unusual to find other types of "assistants" working on the same loom—for example, an apprentice helping the weaver in the case of wide fabrics or those requiring extensive brocading.

19. For a detailed description of the *naqsha* making process, see Jayakar 1967.

20. Traditionally, clasped (or other) string heddles are usually hand-knotted, off-loom, on to the frames of the structure shafts for a fixed warp density. Unlike modern metal heddles that ride freely on metal bars, such heddles are not normally manipulated to allow for variations in the density of successive warps. A change in warp density, therefore, usually entails preparing a new set of structure shafts. In most situations, however, warp density remains unchanged from one warp to the next, the new warp ends simply twisted with the old warp ends.

21. Normally, reversing the direction of motifs regularly in alternate rows is achieved by designing both the motif as well as its reverse image into the *naqsha*, rather than by untying and retying leashes.

22. For a description of the jacquard mechanism, see Watson 1954.

23. In Varanasi, jacquard heads are manufactured in sizes up to 400 hooks for use on the drawloom. In most types of weaving, however, smaller jacquard heads with 200–300 hooks are used. In sari weaving, two heads are used on the same loom, usually one for the body, the other for the side-borders.

24. In this paper, the term "brocading" always refers to a patterning technique—that is the insertion of discontinuous wefts into a foundation weave for patterning purposes. It does not refer to structure as discontinuous pattern wefts can be added in different ways to different foundation weaves.

25. Note that this is not a case of several different patterns being designed within one repeat.

26. In the case of the Indian drawloom, each pattern would require its own *naqsha*. The different *naqsha* would simply have their drawcords tied to the crosscords at different points.

27. This differs, for example, from the practice in Chanderi in central India. Although the same pattern harness is used, the warp ends are entered through the clasp of the heddles in the structure shafts. This would naturally obstruct pattern sheds if the pattern harness were placed behind the structure shafts. Therefore, in a curious departure from drawloom weaving conventions, the pattern harness is placed in front of the structure shafts. See Mohanty 1984, p.37.

28. The difficulty in obtaining a clear shed arises for two reasons: one, the warp ends, not being entered through the clasp of the string heddle, are free to move up or down within the shed height defined by the position of the lifting and depression shafts; second, the electrostatic properties of the silk fiber result in a relatively "sticky" yarn.

29. This problem does not arise if warp ends are entered through the clasp of the string heddle rather than above or below it. In principle, two lifting shafts would then be sufficient for a plain weave foundation. In practice, however, the warp ends would probably still be spaced over at least four (lifting) shafts to avoid overcrowding of heddles. However, pattern sheds get obstructed by the structure shafts and this manner of entering the warp is not suitable for the existing conventions of drawloom weaving in Varanasi.

30. Bier 1987.

31. See "silk brocaded simple satins" discussed below.

32. See note 3.

33. Another double cloth in the collection of the Textile Museum (TM 6.257) but not included in the catalog has been attributed to India on stylistic grounds. The presence of metal wefts with S-wrapped foil and other features indicate that this textile was not woven in India. Other features of the textile that strongly support a non-Indian provenience: (1) the color scheme, with pink and peach tones predominating, suggests an Iranian provenience; (2) an unusually large pattern repeat for what appears to be a relatively light weight furnishing textile (while large pattern repeats are quite common in Iranian and Turkish textiles, in the case of Indian textiles these seem to be a feature only of court commissions with heavy duty end-uses such as tents and floorspreads); (3) the use of a repeating floral pattern that is not offset in alternate rows. These differences between Indian and Iranian textiles are discussed below in greater detail.

34. Textile Museum, Washington, D.C., acc. nos. 6.259 and 6.255; A.E.D.T.A., Paris, accession nos. 2879 A, 2879 B, 2374, and 1692; and the Calico Museum of Textiles, Ahmedabad, acc. nos. 17, 283, 302, 303, 696, and 851.

35. Eiland 1991.

36. These include a carpet in the collection of the Textile Museum, Washington, D.C., accession no. R33.5.1, illustrated as cat. no. 51 in Bier 1987, p. 235, and the so-called "Doria" carpet, in the collection of the Metropolitan Museum of Art, illustrated in Colnaghi 1976, p. 306.

37. Watson 1873.

38. For a detailed discussion, see Sonday 1987.

39. This difference in patterning in India and Iran further supports the re-attribution to Iran of cat. no. 52 (TM 3.95) and cat. no. 53 (TM 6.262) in Bier 1987. In both cases, the repeats are offset and their direction reversed in alternate rows.

40. Sonday and Kajitani 1971a, 1971b.

41. One sari end-panel is in the collection of the Metropolitan Museum of Art, New York, (accession no. 28.50), and is illustrated in Sonday and Kajitani 1971a, p. 51. Very similar in style are three other pieces, one in the collection of the Bharat Kala Bhavan, Varanasi, and two in the collection of the Calico Museum of Textiles, Ahmedabad (accession nos. 605 and L-23). A fifth example is in the Eugene Fuller Memorial Collection at the Seattle Art Museum (accession no. 44.83), and is illustrated in Peebles 1981, p. 15. The sixth example is illustrated in Centro Internazionale 1956.

42. Rowe 1986.

43. Kahlenberg 1972. Kahlenberg's view that the two-layer technique used in the sashes is technically very complex has persisted.

44. The flowering cypress tree motif that appears in the end-panels of several two-layer saris appears in the end-panel of at least one sash. This sash is in the collection of the Yale University Art Gallery (acc. nos. 1937.5310), illustrated in Yale University Art Gallery 1975, p. 16.

45. Of three such saris examined for this study, one is in the collection of the Bharat Kala Bhavan, Varanasi, and is illustrated in Mookerjee 1966, p. 27. The other two are in the collection of the Calico Museum of Textiles, Ahmedabad (accession nos. L-13 and L-17).

46. One such sari end-panel in the collection of the Bharat Kala Bhavan, Varanasi, is dated to about 1700 and attributed to either Surat or Aurangabad, presumably on stylistic grounds.

47. Both groups have a warp pattern step of 2, i.e., one warp of the front layer plus one warp of the back layer.

48. The Textile Museum, Washington, D.C., acc. nos. 6.109 and 6.130.

49. Calico Museum of Textiles, Ahmedabad, acc. no. 80.

50. Both covers are in the collection of Bharat Kala Bhavan, Varanasi, and are illustrated in Mehta 1970, pls. 22 and 23.

51. One canopy or saddle-cover is in the collection of the Cincinnati Art Museum (acc. no. 1943.909), and is illustrated in Smart and Walker 1985, cat. no. 74. The other piece is at the Victoria & Albert Museum (acc. no. 0683 IS), illustrated in Guy and Swallow 1990, fig. 196, p.222.

52. Taszycka 1968.

53. Irwin 1959.

54. Irwin notes that English records from 1609 show sashes to be a prominent part of India's textile shipments to London, increasing greatly in the 1620s.

55. Mehta 1970, pls. 22 and 23. Mehta probably obtained this information from Birdwood 1880, pl. 68, or from Wardle 1886, pp. 13–14. Watt and Brown 1904, p. 326, notes that, among the "100-year old" Ahmedabad brocades on display at the Delhi Exhibition of 1903, were "small squares or table covers worked in the design figured by Sir George Birdwood (Industrial Arts of India, pl. 68)."

56. Victoria & Albert Museum; see note 30.

57. For example, among a set of seven sashes belonging to Nizam Asaf Jah of Hyderabad (who ruled 1724–48), at least three can be identified as Iranian on this basis. One is illustrated in Slomann 1953, fig. 90, p. 141; a second one in Geijer 1951, no. 46, p. 105; the third in Pope and Ackerman 1964, plate 1074B.

58. The velvets include: Victoria & Albert Museum accession no. 320a–1898, illustrated in Guy and Swallow 1990, p. 96; A.E.D.T.A. accession no. 2879b, illustrated in Riboud 1989, p. 34; Chester Beatty Library accession no. 81.6/43, illustrated in Smart 1987, p. 23. One of the *lampas* floorspreads is in the collection of The Textile Museum, Washington, D.C., accession no. 6.279; an identical floorspread is in the collection of the Calico Museum, Ahmedabad.

59. The median width is that which occurs most frequently in the sample.

60. Taszycka 1968.

61. Kahlenberg 1972.

62. Dr. Naval Krishna, Curator, Mehrangarh Museum Trust, Jodhpur, India, shared with the author the same observation in Varanasi in January 1992.

63. The names given to this and the following groups of textiles are merely names of convenience for stylistic identification, not intended to describe structure or technique of the textiles within the group and, therefore, do not follow any established technical vocabulary.

64. These characteristics appear in cat. no. 69 in Bier 1987 and strongly suggest an Indian provenance for that textile.

65. "Reed marks" refer to visible gaps in the cloth in the length direction between groups of warps entered into the dents of the reed. They occur because, in beating, the wires of the reed push apart warps entered into adjacent dents.

66. Riefstahl 1923, nos. 149, 155, 156, and 158.

67. Mehta 1970, plates.

68. Singh 1979, cat. no. 429, plate 6C.

69. Watson 1873, no. 431, volume on kincobs.

70. Watson 1873, no. 438, volume on kincobs.

71. Wardwell 1988–89, pp. 95–96.

72. Riefstahl 1923, nos. 160–168, and others of this type among nos. 176–279.

73. Nabholz-Kartaschoff 1986, fig. 7, p. 8.

74. Nabholz-Kartaschoff 1986, fig. 18, p. 16.

75. The swatches do not include selvedges and, therefore, it cannot be determined if the Varanasi products differ from those of Ahmedabad in this respect.

76. Stronge 1990, pl. 41, p. 92.

77. In a personal communication, Gabriel Vial, the foremost authority on the French drawloom tradition, indicated that in cases when two or more patterns are used simultaneously, all the lashes are laced in consecutive order on the simple cords. There is, thus, only one set of lashes, unlike the Indian case, where a separate *naqsha* is prepared (and independently operated) for each pattern.

78. Mehta 1970, p. 13. Mehta's information is taken from Mookerji 1894.

79. In the collection of the National Handlooms and Handicrafts Museum, New Delhi, on display during January 1992.

80. The number of crosscords required for specific groups of Iranian textiles are calculated from the technical information supplied in Bier 1987. Metal-ground textiles requiring 350–600 crosscords include cat. nos., 4, 13, 16, 17, 18, 20, 21, and 62.

81. Bier 1987, cat. nos. 1, 22, 24, 27, and 59.

82. Bier 1987, cat. nos. 2, 10, 29, 30, 33, 35, and 55.

83. The *lampas* textiles, being weft-patterned and having several wefts of different colors running in each shed, naturally required more lashes compared to the warp-patterned velvets (requiring more cross-cords).

84. King and King 1990.

85. One manifestation of this was the increased use of plain-weave derived weaves of the Gros de Tours type or the Cannele type to provide fancier foundations for supplementary-weft brocading. For a description of these weave types, see Wolfensberger 1921, p. 19, and pp. 49–55.

86. According to Gabriel Vial, personal communication.

87. Rothstein 1990.

88. Arizzoli-Clementel 1990; Adrosko 1983.

References cited

Adrosko, Rita J.
1983 The Jacquard and Woven Silk Pictures, *Ars Textrina*, vol. 1, December, pp. 9–75. Charles Babbage Research Centre, Winnipeg, Manitoba.

Arizzoli-Clementel, Pierre
1990 *The Textile Museum, Lyons.* The Textile Museum, Lyons.

Becker, John
1987 *Pattern and Loom.* Rhodos International Publishers, Copenhagen.

Bier, Carol (editor)
1987 *Woven from the Soul, Spun from the Heart.* The Textile Museum, Washington.

Birdwood, George C.M.
1880 *The Industrial Arts of India.* Idarah-I-Adabiyat-I, Delhi.

Burnham, Dorothy K.
1980 *Warp and Weft: A Dictionary of Textile Terms.* Charles Scribner's Sons, New York.

Centro Internazionale delle Arti & del Costume
1956 *Textile Art and Costumes of India.* Centro Internazionale della Arti & del Costume and All-India Handloom Board, Venice.

Colnaghi
1976 *Persian and Mughal Art.* Colnaghi, London.

Crill, Rosemary
1992 Vrindavani Vastra: Figured Silks from Assam, *Hali*, vol. 14, no. 2, issue 62, April, pp. 76–83. London.

DuBois, Emily
1985 Banaras Brocade, *Ars Textrina*, vol. 3, May, pp. 209–227. Charles Babbage Research Centre, Winnipeg, Manitoba.

Eiland, Murray
1991 The Moghul Strapwork Carpets, *Oriental Rug Review*, vol. 11, no. 6, August/September, pp. 28–37. Meredith, New Hampshire.

Emery, Irene
1980 *The Primary Structures of Fabrics: an Illustrated Classification.* The Textile Museum, Washington. Originally published 1966.

Geijer, Agnes
1951 *Oriental Textiles in Sweden.* Rosenkilde and Bagger, Copenhagen.

Guy, John, and Deborah Swallow (editors)
1990 *The Arts of India: 1550–1900.* Victoria & Albert Museum, London.

Hill, Patricia
1990 Translation of Nathaniel Lumscher's *Neu eingerichtetes Weber Kunst und Bild Buch* (published in 1708), *Ars Textrina*, vol. 14, December, pp. 15–16. Charles Babbage Research Centre, Winnipeg, Manitoba.

Hooper, Luther
1953 *Handloom Weaving: Plain and Ornamental.* Sir Isaac Pitman, London.

Irwin, John.
1959 A Note on the Indian Sashes of King Gustavus Adolphus, *The Journal of Indian Textile History,* vol. 4, pp. 69–76. Calico Museum of Textiles, Ahmedabad.

Jain, Jyotindra and Jasleen Dhamija (editors)
1989 *Handwoven Fabrics of India.* Mapin Publishing Pvt., Ahmedabad.

Jayakar, Pupul
1967 Naksha Bandhas of Banaras, *Journal of Indian Textile History,* vol. 7, pp. 21–44. Calico Museum of Textiles, Ahmedabad.

Kahlenberg, Mary M.
1972 A Study of the Development and Use of the Mughal Patka (Sash) with Reference to the Los Angeles County Museum of Art Collection, *Aspects of Indian Art,* pp. 153–166. Edited by Pratapaditya Pal. E.J. Brill, Leiden.

King, Monique, and Donald King
1990 *European Textiles in the Keir Collection.* Faber and Faber, London.

Mehta, Rustam J.
1970 *Masterpieces of Indian Textiles.* D.B. Taraporevala Sons & Co. Pvt., Bombay.

Mohanty, B.C.
1984 *Brocaded Fabrics of India.* Calico Museum of Textiles, Ahmedabad.

Mookerjee, Ajit (editor)
1966 *Banaras Brocades.* Crafts Museum, New Delhi.

Mookerji, Nitya Gopal
1894 The Silk Industries of Bengal, *Journal of Indian Art,* vol. 5. W. Griggs, London.

Nabholz-Kartaschoff, Marie-Louise
1986 *Golden Sprays and Scarlet Flowers.* Shikosha Publishing Ltd., Kyoto.

Peebles, Merrily
1981 *Court and Village: India's Textile Traditions.* Santa Barbara Museum of Art, Santa Barbara, California.

Pope, Arthur Upham, and Phyllis Ackerman (editors)
1964 *A Survey of Persian Art,* vol. 11. Ashiya, Japan.

Riazuddin, Akhtar
1988 *History of Handicrafts.* National Hijra Council, Islamabad.

Riboud, Krishna (editor)
1989 *In Quest of Themes and Skills—Asian Textiles.* Marg Publications, Bombay.

Riefstahl, R. M.
1923 *Persian and Indian Textiles.* E. Weyhe, New York.

Rothstein, Natalie
1990 *Silk Designs of the Eighteenth Century.* Victoria & Albert Museum, London.

Rowe, Ann Pollard
1986 The Woven Structures of European Shawls in the Textile Museum Collection, *The Textile Museum Journal,* vol. 24, 1985, pp. 55–59. The Textile Museum, Washington.

Serjeant, R. B.
1972 *Islamic Textiles: Material for a History up to the Mongol Conquest.* Librairie du Liban, Beirut.

Singh, Chandramani
1979 *Textiles and Costumes from the Maharaja Sawai Man Singh II Museum.* Sawai Man Singh II Museum Trust, Jaipur.

Slomann, Vilhelm
1953 *Bizarre Designs on Silk.* E. Munksgaard for Ny Carlsberg Foundation, Copenhagen.

Smart, Ellen S.
1987 A Preliminary Report on a Group of Important Indian Textiles, *The Textile Museum Journal,* vol. 25, 1986, pp. 5–23. The Textile Museum, Washington.

Smart, Ellen S. and Daniel S. Walker
1985 *Pride of the Princes: Indian Art of the Mughal Era in the Cincinnati Art Museum.* Cincinnati Art Museum, Cincinnati.

Sonday, Milton
1987 Pattern and Weaves: Safavid Lampas and Velvet, *Woven from the Heart, Spun from the Soul,* pp. 57–83. Edited by Carol Bier. The Textile Museum, Washington.

Sonday, Milton, and Nobuko Kajitani
1971a A Type of Mughal Sash, *The Textile Museum Journal*, vol. 3, no. 1, 1970, pp. 45–54. The Textile Museum, Washington.

1971b A Second Type of Mughal Sash, *The Textile Museum Journal*, vol. 3, no. 2, pp. 6–12. The Textile Museum, Washington.

Stronge, Susan
1990 *The Decorative Art of India.* Portland House, New York.

Taszycka, Maria
1968 Ceintures de soie—accessoires du costume de gentilhomme polonais, *Bulletin de Liaison du Centre International d'Étude des Textiles Anciens*, no. 27, January, pp. 85–147. Lyon.

Wardle, Thomas
1886 The Indian Silk Culture Court at the Colonial and Indian Exhibition, *The Journal of Indian Art*, vol. 1, no. 15, pp. 115–123. W. Griggs, London.

Wardwell, Anne E.
1988–89 *Panni Tartarici:* Eastern Islamic Silks Woven with Gold and Silver, *Islamic Art*, vol. 3, pp. 95–175. The Islamic Art Foundation, New York.

Watson, J. Forbes
1873 *Collection of Specimens of The Textile Manufactures of India*, (Second Series). India Museum, London.

Watson, W.
1954 *Textile Design and Colour.* Sixth edition, revised by E.G. Taylor and J. Buchan. Longmans, Green, London.

Watt, George and Percy Brown
1904 *Arts and Crafts of India.* Cosmo Publications, New Delhi.

Wolfensberger, Arnold
1921 *The Theory of Silkweaving.* Clifford and Lawton, New York.

Wulff, Hans
1966 *The Traditional Crafts of Persia: Their development, technique, and influence on Eastern and Western Civilizations.* The M.I.T. Press, Boston.

Yale University Art Gallery
1975 *The Kashmir Shawl.* Yale University Art Gallery, New Haven, Connecticut.